Ellsworth Air Force Base

Initial Five Year Review

Submitted by

United States Air Force
Air Combat Command

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FINAL
FIVE YEAR REVIEW
ELLSWORTH AFB, SOUTH DAKOTA

UNITED STATES AIR FORCE
AIR COMBAT COMMAND

SEPTEMBER 19, 2000
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1.0 INTRODUCTION

The United States Air Force has completed the first five-year review of the remedial actions at Ellsworth Air Force Base (EAFB) located in Meade and Pennington Counties South Dakota. This review was conducted from April 2000 through July 2000. This report documents the results of the review. The purpose of the five-year review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in the five-year review report. In addition, five-year review reports identify deficiencies found during the review, if any, and identify recommendations to address them.

1.1 PURPOSE OF THE REVIEW

This review is required by statute. Five year reviews must be implemented in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA § 121 (E), as amended, states:

> "If the president selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented."

The NCP part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

> "If a remedial action is selected that results in hazardous substances, pollutants. or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action."

1.2 REVIEW PROCESS

Contractors prepared portions of this review for the Air Force. The Air Force, using its contractual arrangements via its Corps of Engineers Total Environmental Restoration Contract (TERC), contracted with Earth Tech, Inc. to provide information for all or part of report sections 4, 5, 6, 7, 8. 9, 10, and 12. In addition, RD Todd & Associates was contracted to Earth Tech, Inc. to assist in the development of all or portions of report sections l, 2, 3, 4, 6, and 7. These evaluations were conducted from April 2000 through July 2000.

This is the first statutory five-year review for EAFB. The triggering action for this review is the initiation of an interim remedial action at Operable Unit 4 (Landfill 3) following IA ROD signing on 16 May 1995. Due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unrestricted use and limited exposure, a five-year review was required.

The review covers remedial actions taken at twelve operable units (OUs) at EAFB. In addition, reviews were conducted for two non-CERCLA sites undergoing remedial action under State of South Dakota programs. The sites reviewed include:

CERCLA Sites:

OU-1	Fire Protection training Area
OU-2	Landfills Nos. 1 and 6
OU-3	Landfill No. 2
OU-4	Landfill No. 3
OU-5	Landfill No. 4
OU-6	Landfill No. 5
OU-7	Weapons Storage Area
OU-8	Explosive Ordnance Disposal Area (Pramitol Spill)
OU-9	Old Auto Hobby Shop Area
OU-10	North Hangar Complex
OU-11	Base-wide Ground Water (Including AOC-24)
OU-12	Hardfill No. 1

Non-CERCLA Sites:

JP-4 Release south of Operable Unit 2
JP-4 Release Flightline Refueling Area

2.0 SITE CHRONOLOGY

Ellsworth AFB was officially activated in July 1942 as the Rapid City Army Air Base. It became a permanent facility in 1948, with the 28th strategic Reconnaissance Wing as its host unit. Throughout its history, EAFB has been the base of operations for a number of types of aircraft and missile systems. Presently, the 28th Bombardment Wing (B1-B bombers) is the host unit. The following three tables provide a summary of the History of Installation Operations at EAFB (Table 2-1), Key Regulatory Actions Impacting EAFB (Table 2-2), and Site Closure Status (Table 2-3)

TABLE 2-1

HISTORY OF INSTALLATION OPERATIONS AT EAFB
(from Management Action Plan EAFB, South Dakota-1999)

Period	Types Of Operations	Weapon System	Waste Generating Activities
Pre-1939	Rangeland	None	None
1939-1941	Rapid City Airport	None	Fuel/oil storage
1941-1942	EAFB construction	None	Construction/demolition
1942-1945	Bomber Training Wing	B-17 Bomber crew training, weapons storage for bombers	EAFB landfills, airplane and automotive fuel storage, hangars, machine shops (solvents, oils, metals)
1945-1946	Weather Reconnaissance Squadron training	Reconnaissance	Weapon storage areas, landfills, water treatment facility, fuel/oil storage
1946-1947	Inactive	None	None
1947-1957	Bomber Wing	B-36 Bombers	Weapons storage area, low-level nuclear waste storage area. explosive ordnance disposal area, fire protection training areas, machine shops, fuel/oil storage, fuel pump houses, sludge burial, landfills
1957-1959	Bomber Wing	B-52 Bombers	Weapons storage area, landfills, low-level nuclear waste storage area, explosive ordnance disposal area, fire protection training areas, machine shops, fuel/oil storage, fuel pump houses, sludge burial, buried tanks
1960-1965	Bomber Wing Missile Wing	B-52 Bombers Titan I missiles KC-135 Tankers EC-135 Reconnaissance T-38 Trainers	Weapons storage area, low-level nuclear waste storage area. landfills, explosive ordnance disposal area, fire protection training areas, machine shops, fuel/oil storage, fuel pump houses, sludge burial, various dumping areas, buried tanks, low level nuclear waste
1962-1992	44th Strategic Wing	Minutemen Missiles B-52 Bombers B-1 Bombers KC-135 Tankers UH-1 Helicopters T-38 Trainers	Oil/water separators, landfills, buried fuel/oil tanks, fire protection training areas, burn pits, weapons storage area, wastewater treatment facility, drum storage areas, machine shops, fuel/oil storage, fuel pump houses, explosive ordnance disposal area, low-level nuclear waste
1993-1994	28th Bombardment Wing	B-1 Bombers KC-135 Tankers UH-1 Helicopters T-38 Trainers	Oil/water separators, landfills, buried fuel/oil tanks, fire protection training areas, weapons storage area, wastewater treatment facility, drum storage areas, machine shop, fuel/oil storage, fuel pump houses, explosive ordnance disposal area

Period	Types Of Operations	Weapon System	Waste Generating Activities
1994-mid 1995	28th Bombardment Wing	B-1 Bombers T-38 Trainers	Oil/water separators, landfills, buried fuel/oil tanks, fire protection training areas, weapons storage area, wastewater treatment facility, drum machine storage areas, shop, fuel/oil storage, fuel pump houses, explosive ordnance disposal area, low-level nuclear waste
Mid-1995 to present	28th Bombardment Wing	B-1 Bombers	Oil/water separators, landfills, buried fuel oil tanks, fire protection training areas, weapons storage area, wastewater treatment facility, drum storage areas, machine shop, fuel/oil storage, fuel pump houses, explosive ordnance disposal area,

TABLE 2-2

KEY REGULATORY ACTIONS IMPACTING EAFB
(from Management Action Plan EAFB, South Dakota-1999)

Date	Action	Details
September 1985	PA/SI Records Search	Completion of PA/Records Search by EAFB
June 1988	Phase II, Stage I	Report became final
December 1989	Phase II, Stage II	Report became final
October 26, 1989	Proposed NPL	EAFB proposed for National Priority List
August 30,1990	NPL	EAFB Final Listed on NPL with 12 operable units
January 24, 1992	FFA	USAF, EPA, South Dakota complete FFA
April 1, 1992	RI/FS	Initiated in accordance with FFA
July – August 1995	Public Comment	Public Comment Period, OU-6 Proposed Plan. Public meeting held 25 July, 1995
October 1995	OU-6 ROD	ROD Execution by USAF, EPA and SDDENR
September – October 1995	Public Comment	Public Comments Period for OU-1,2,4 Proposed Plans. Public meeting held January 11, 1996
December 1995 – January 1996	Public Comment	Public Comment Period for OU-3,5,7,8,9,10,12 Proposed Plan. Public meeting held January 11, 1996
May 1996	RODS, OU-1,2,4,9,10,12	ROD Execution by USAF, EPA and SDDENR
June 1996	RODS, OU-3,5,7,8	ROD Execution by USAF, EPA and SDDENR
September 1996	RA Report, OU-6	RA Report approved by EPA
February – March 1997	Public Comment	Public Comment Period for OU-11 Proposed Plan. Public meeting held February 19, 1997
April 1997	ROD, OU-11	ROD Execution by USAF, EPA and SDDENR
September 1997	RA Reports	Approval by EPA of RA Reports for OU-1,2,3,4 (IRA and Final Action), 5,7,8 and 12

TABLE 2-3

SITE CLOSURE STATUS
(from Management Action Plan EAFB, South Dakota-1999)

Site No.	Draft RA Report	Final Construction Inspection-	Final Regulatory Inspection	Final RA Report	RA Report Approval
CERCLA SITES					
IRA (OU-1)	**7/12/96**	**7/96**	**7/2/96**	**8/22/96**	**9/30/96**
IRA (OU-4)	**9/23/96**	**8/8/96**	**2/20/97**	**5/9/97**	**9/8/97**
OU-1	**11/1/96**	**6/6/97**	**7/17/97**	**7/25/97**	**9/25/97**
Rad Removal (OU-2)	**11/5/97**	**12/2/97**	NA	**12/22/97**	NA
OU-2	**9/23/96**	**5/1/97**	**11/6/96**	**5/9/97**	**9/8/97**
OU-3	**11/1/96**	**5/1/97**	**2/20/97**	**5/9/97**	**9/8/97**
OU-4	**11/1/96**	**4/15/97**	**2/20/97**	**6/11/97**	**9/25/97**
OU-5	**11/1/96**	**5/1/97**	**2/20/97**	**5/9/97**	**9/8/97**
OU-6	**6/96**	**7/2/96**	**7/2/96**	**7/31/96**	**9/30/96**
OU-7	**9/5/97**	**12/2/97**	**9/23/97**	**9/26/97**	**9/29/97**
OU-8	**11/1/96**	**6/6/97**	**2/20/97**	**6/11/97**	**9/8/97**
OU-9	**1**	NA	NA	NA	NA
OU-10	**1**	NA	NA	NA	NA
OU-11	**9/8/97**	**12/18/97**	**1/14/98**	**12/10/99**	**2/10/00**
OU-12	**11/1/96**	**5/1/97**	**11/6/96**	**5/9/97**	**9/8/97**
	Draft Completion Report	**Final Construction Inspection**	**Final Regulatory Inspection**	**Final Completion Report**	**Approval**
NON-CERCLA SITES					
SS-08[2]			NA	NA	NA
ST-10[3]			**6/19/97**	**12/19/97**	**12/29/97**
ST-14[4]				**12/19/97**	**12/29/97**
WP-22[5]	**5/8/97**		**5/7/97**	**6/17/97**	**9/16/97**
ST-236	NA	NA	NA	NA	NA
JP-4 (OU-2)[7]	NA	**3/25/97**	**6/19/97**	**12/19/97**	**12/29/97**
ST-17[8]	NA	NA	NA	**6/18/97**	**4/30/98**
OT-18[9]	NA	NA	NA	NA	NA
OT-16[10]	NA	NA	NA	NA	NA

1 No-Action OU; Completion occurred when ROD was signed in May, 1996
2 Spill Site Jet Fuel Pump House 7
3 Jet Fuel Line Leak Pump House Hydrant
4 Jet Fuel Spill Site Pump House 6
5 Abandoned Industrial Waste Water Treatment Plant
6 Abandoned WWII Petroleum Oil Lubricant (POL) System. ST-23 is being addressed as part of the OU- 11 South Docks Ground Water Remedial Action
7 JP-4 Pipeline puncture leak south of OU-2
8 Basewide UST locations
9 Badlands Bombing Range Impact Area. Administratively closed; work proceeding under Federal Facilities Compliance Act.
10 Jet Fuel Spill 70 Row Hanger Complex. Pump house 7 and UST have been removed; DENR Closeout Pending.

3.0 BACKGROUND

3.1 BASEWIDE

Ellsworth AFB is located 12 miles east of Rapid City, South Dakota, and adjacent to the small community of Box Elder. The main Air Base covers 4.858 acres within Meade and Pennington Counties. The Base includes runways, airfield operations, industrial areas, housing and recreational facilities. Open land, containing individual residences, lies to the north, south, and west of EAFB, while residential and commercial areas lie to the east (Figure 3-1).

On August 30, 1990, (55 FR 35509), EAFB was listed on the U.S. Environmental Protection Agency's (EPA's) National Priorities List. A Federal Facility Agreement signed in January 1992 went into effect on April 1, 1992. The FFA identified 11 potential source area Operable Units as well as a Basewide ground water Operable Unit (Figure 3-2). In addition, the South Dakota Department of Environment and Natural Resources (SDDENR) provides oversight for several petroleum release sites, which are mentioned in this report but are not addressed under CERCLA. Ground water extraction systems are in operation to address ground water contamination associated with the JP-4 plume and the Flightline Refueling Area (FRA).

Rapid City, located approximately 6 miles west of EAFB, is the second largest city in the state, with a population of more than 54,000 (U.S. Department of Commerce, 1992). Access to national rail lines, Interstate Highway 90, commercial airlines, and state highways has created a transportation hub in Rapid City. The economy of the Rapid City area is composed of light industry, tourism. agriculture, and a variety of service industries.

EAFB is located on the border of Pennington and Meade Counties, and the southernmost property line is approximately 4800 ft north of the Box Elder corporate limits. The estimated population within a four-mile radius of the Base was 12,000 in 2000. The Base employs nearly 3,700 people, consisting of about 3,255 active-duty military, and the remainder composed of civilian personnel. There are approximately 2,894 enlisted personnel, 358 officers and 7,500 dependents living on Base (EAFB, Public Affairs Office).

Land use on and around EAFB is a mixture of industrial (primarily on-Base), commercial, residential, and agricultural uses. EAFB is an active military installation, comprised of runways and airfield operations, industrial areas, housing, and recreational facilities. The on-Base residential areas are located along the eastern boundary of EAFB. Ranches lie to the north and west of the Base, and residential and commercial areas lie to the east. Residences and ranches lie south of EAFB. Private residences are located within a few thousand feet of the EAFB southwestern boundary. The closest residence to EAFB is approximately 300 feet southwest of Operable Unit 4 (Landfill 3). There are other residences in the same vicinity. The nearest residence to OU-1 is approximately 1,500 feet south of the southern edge of the FPTA, and 600 feet west of OU-2.

Shallow ground water in the area is used for domestic water supplies and for livestock watering. According to the Ellsworth Air Force Base Public Health Assessment report prepared by the Agency for Toxic Substance and Disease Registry (ATSDR), (U.S. Department of Health and Human Services, 1993), some nearby off-Base residents use shallow (less than 70 ft below grade) private wells for both household and livestock water supplies. The Air Force has completed a detailed investigation of off-site ground water to obtain data pertaining to water quality of off-site residential wells in support of the OU-11 RI.

Ground water resources provide most of the water supplies required by municipal, industrial, domestic and agricultural consumers in the study area. The Rapid City municipal distribution system obtains its water supplies from two deep high-capacity wells finished into the bottom of the Pennsylvanian Minnelusa Formation and the upper Mississippian Madison Group (Pahasapa Limestone), three infiltration galleries finished along Rapid Creek and from a surface water intake on Rapid Creek that is more than five miles west of EAFB (USAF, 1985). EAFB obtains its potable water from the Rapid City Municipal Distribution System. In past years, EAFB obtained its water supplies from its own wells. A total of five wells had been installed into deep bedrock aquifers at the Base. These wells were taken out of service by the Air Force and have been abandoned following State of South Dakota requirements. The town of Box Elder's municipal distribution system receives water from four wells more than 2 miles south of EAFB. Three of the wells are finished into the Inyan Kara Group (Cretaceous Fall River and Lakota Formations) at depths of 2,000 feet or more, and one well has been completed into the Madison Group (Pahasapa Limestone) at a depth of 4,180 feet below grade (USAF, 1985). Other than the shallow wells outside the southwest corner of the Base, it is reported that ranches and rural homes in the area depend on wells completed into the Inyan Kara Group at depths of at least 1,700 feet below land surface for water supplies (U.S. Department of Health and Human Services, 1993). Five off-Base private domestic wells are situated within 2,500 feet of the western and southern boundaries of EAFB near OU-1. The closest well, PW05, is approximately 300 feet west of OU-1. The closest downgradient private domestic supply well from OU-1 (PW01) is approximately 1,300 feet downgradient (southeast) of the OU.

The major streams near EAFB are Box Elder Creek, Elk Creek, and Rapid Creek, all of which are located in the Missouri River Basin. Box Elder Creek is an ephemeral stream, while Elk Creek and Rapid Creek are perennial streams that support a permanent fish population.

Surface water runoff at EAFB discharges from the Base property through eight outfalls (Figure 3-3). Outfalls 007, 008, and 009 flow north to the Elk Creek drainage. Outfalls 001, 002, 003, and 006 flow south to the Box Elder Creek drainage. An additional Outfall (005) is located at the Base Waste Water Treatment Plant (WWTP) and discharges from the Base through Outfall 006. The outfalls carrying water north to the Elk Creek drainage have low to no flows and therefore are not routinely monitored. The remaining outfalls are monitored on a specific schedule as specified in applicable National Pollutant Discharge Elimination System (NPDES) Permit requirements.

Flow to the south into the Box Elder drainage is more significant and comprises the majority of runoff from the Base. The flows leave the Base to the south from Outfalls 001, 002, 003, and 006. Flow from Outfall 005 (WWTP) enters a drainage way and leaves the Base through Outfall 006. The water leaving the Base flows through drainageways into the Box Elder Creek segment between S22, T2N, R8E and Haines Avenue in Rapid City. Surface water in the area is used to water livestock and it also supports limited aquatic populations. Fishing is allowed in on-Base lakes.

EAFB experiences temperature variations that are typical of semi-arid continental climates. The Black Hills to the west of EAFB exerts a pronounced influence on the climate in this area (National Climatic Data Center, 1992). Summer days are warm, with cool comfortable nights. The average summer temperature is 68 ºF, and the daily high average is 81 ºF. July is the hottest month, and the highest recorded temperature was 110 ºF in July 1989. Winters are relatively mild, due to the protection of the Black Hills and the frequent occurrence of Chinook winds. The average winter temperature is 26 ºF, with an average daily minimum of 14.9 ºF. The coldest month, on the average is

January, and the lowest recorded temperature was -30 ºF in December 1990. Snowfall is normally light, with the greatest monthly average of about 8 inches occurring in March.

Average annual precipitation is 16.3 inches. Most precipitation falls during the spring and early summer months. April through July average 2.5 in. per month of precipitation, and June has the highest monthly average with 3.3 inches. The average relative humidity is 71 percent at dawn, and 50 percent in the late afternoon. Prevailing winds are from the north and northwest at a mean speed of 11.3 mph (U.S. National Weather Service, Asheville, North Carolina).

Remedial Investigations (RI) completed at EAFB at the 12 operable units resulted in the collection of media samples from soil. Sediment, ground water and surface water. The primary list of analytes collected at each operable unit and at the background locations were identical. Analysis of additional site specific analytes was conducted at OU-7 (radiological), OU-8 (explosives, dioxins and Pramitol), and OU-1 (dioxins). The primary analytes included:

SOIL SAMPLES	**STREAM SEDIMENT**
TCL VOC (8240)	TCL VOC (8240)
TCL SVOC (8270)	TCL SVOC (8270)
TCL Pesticides/PCBs (8080)	TCL Pesticides/PCBs (8080)
TAL Metals	TAL Metals
Dioxin/Furan (1613)	Dioxin/Furan (1613)
Cyanide (9012)	Cyanide (9012)
TRPH (8015)	TRPH (8015)
SURFACE WATER	**GROUND WATER**
TCL VOC (8240)	TCL VOC (8240)
Vinyl Chloride (8010)	Vinyl Chloride (8010)
TCL SVOC (8270)	TCL SVOC (8270)
Polycyclic Aromatic Hydrocarbons (8100)	Polycyclic Aromatic Hydrocarbons (8100)
Pentachlorophenol (8150)	Pentachlorophenol (8150)
TCL Pesticides/PCBs (8080)	TCL Pesticides/PCBs (8080)
TAL Metals (total & dissolved)	TAL Metals (total & dissolved)
Cyanide (9012)	Cyanide (9012)
TRPH (8015)	TRPH (8015)

3.2 OPERABLE UNIT 1 FIRE PROTECTION TRAINING AREA (FPTA)

3.2.1 Physical Setting

The topography of OU-1 is characterized by a local topographic high, especially in the area where the fire training was conducted, which is bounded on the southwest and southeast by drainages that converge to from a southerly pointing apex. Surface water, which flows onto and through OU-1 originates from several separate sources. these source areas, from upstream to downstream, are discussed below and illustrated on Figure 3-3.

The main drainage channel at OU-1 flows from north to south along the eastern perimeter of OU-1. The main channel drains a portion of the southern area of EAFB including some of the hangar complex, runways and OU-12. The main channel is approximately 12-15 ft across and 3-4 ft deep. The channel is considered to be ephemeral: however, standing water was observed in the channel throughout the

1993 RI field investigation. The main drainage channel eventually empties into the upstream end of Pond 001. Flow in the drainage ditch along the southeast boundary of OU-1 originates as surface water run-off from the landfill area (OU-12) to the northeast of OU-1 and from drainage pipes that discharge storm water run-off from the South Docks area of the flight line and from portions of the adjoining taxiways and flight lines. Flow was measured at approximately 1 cubic foot per second (cfs) above Pond 001 during the OU-1 field investigation.

A secondary shallow drainage ditch delivers surface runoff from the eastern portion of the FPTA to the main drainage channel. This secondary drainage ditch is generally dry. Two drainage culverts extend beneath the alert apron and discharge surface water from the east into the main drainage channel. The source of the discharge from these two culverts is presumed to be runoff from the alert apron.

Surface water runoff from the above sources is temporarily held in Pond 001 (Figure 3-4). Pond 001 is located at the southern extreme of the Operable Unit. At the downstream end of the pond is an oil skimmer and earthen dam. On the downstream side of the skimmer, flow passes through piping beneath Kenney Road and discharges into an open drainage ditch on the west end of OU-2. The skimmer consists of a floating "weir" device and two discharge pipes. The skimmer is designed to allow water to exit Pond 001 without allowing light non-aqueous phase liquids (LNAPL) or floating debris to discharge. In addition, a floating aerator is used in the Pond to help oxygenate water.

A secondary unnamed ephemeral drainage channel is located along the southwestern edge of OU-1 and receives surface water runoff from off-Base west of OU-1 and from runoff from the western edge of the FPTA. This ancillary drainage channel empties into Pond 001 beneath the main channel approximately 200 ft downstream of the main drainage channel. The flow in the drainage along the southwest boundary of OU-1 originates as sheet flow and surface run-off from fields to the northwest of OU-1. There was no measurable discharge in this drainage ditch during the OU-1 field investigation although there was standing water.

The slope break into the unnamed ephemeral drainage to the southwest is gentle, whereas the slope break into the unnamed main drainage, to the southeast, is much steeper. Wetlands were found along both drainageways and along Pond 001. The relief from the topographic high of OU-1 to the pond is approximately 40 ft.

3.2.2 Land and Resource Use

OU-1 contained the Former Fire Protection Training Area (FPTA) and is located on the southwest portion of EAFB northwest of the alert apron and east of Kenny Road. OU-1 covers approximately ten acres and consisted of a centrally located, unlined, bermed burn pit, a steel aircraft mockup and surrounding land. The burn pit area was the source area of contamination.

This OU is currently being remediated and is closed to access, except for Base personnel and contractors responsible of the operation of the remedial systems. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

Operable Unit 1 has several habitat features, most of which are heavily influenced by human activities such as past burn usage and current maintenance. In spite of this disturbance, some natural habitat still exists in the form of grassland, weedy areas, and a small portion of wetlands, that would attract animal species that would be potential contaminant receptors. The U.S. Fish and Wildlife Service National

Wetland Inventory Map (NWI) classifies the wetland community type present on OU-1 as Palustrine Emergent Seasonally Flooded (PEMC).

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or fauna species classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

3.2.3 History of Contamination

The FPTA was operated by the EAFB Fire Department from 1942 to 1990 at this location. The location of the burn area within the former FPTA has changed several times over the years. Aerial photographs of EAFB dated May 28,1952, October 8, 1954, August 25,1962, and June 19,1968, show numerous areas of staining presumed to be a result of fire training activities within the former FPTA. The training exercises conducted at the FPTA involved simulation of aircraft fires and spills. Various types of fuels, oils, and solvents were dispersed within the burn-pit area and subsequently ignited and then extinguished.

Soils at OU-1 contained JP-4 (jet fuel): benzene, toluene, ethylbenzene, xylenes (BTEX); and, chlorinated volatile organic compounds (VOCs). JP-4 concentrations were much higher than other compounds (Figure 3-5). Ground water at OU-1 contained chlorinated VOCs, BTEX and JP-4. LNAPLS were present in the northern and southern end of the FPTA. Dense non-aqueous phase liquids (DNAPLS) were not present at OU-1. Ground water contamination in this area did not extend beyond the Base boundary (Figure 3-6).

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-1. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Noncarcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The risk assessment for OU-1 indicated unacceptable risk in the shallow ground water for the future residential exposure scenarios. The chemicals, which contributed the majority of the risk in shallow ground water, were VOCs. Of the VOCs, benzene, 1,2-dichloroethane, (1,2-DCA) 1,1-dichloroethylene (1,1-DCE), 1,2-dichloroethylene (1,2-DCE), 1,1,1-trichloroethane, perchloroethylene (PCE), trichloroethylene (TCE), and vinyl chloride were identified as being above their respective maximum contaminant levels (MCLs).

The risk assessment indicated that unacceptable future risk exists in the soils of the burn-pit area, primarily from the potential for contaminating the underlying ground water. In order to prevent future contamination of the ground water, four VOCs were identified for remediation in soils: benzene, 1,2DCE, PCE, and TCE. These chemicals were selected for remediation on the basis of a contaminant transport model. Remediation of jet fuel in the soil at OU-1 is also required because concentrations of jet

fuel (and related components) exceed State of South Dakota regulations. Risks from exposure to pesticides and dioxins/furans in surface and subsurface soils at OU-1 were well below the acceptable range and do not warrant remediation.

The current and future risk from the contaminants in the sediments and surface water at OU-1 is within the acceptable risk range. Several compounds were detected in surface water at above the Federal Ambient Water Quality Criteria (FAWQC), but the risk to human health from these contaminants is within the acceptable risk range ((10-4, (1 in 10,000) to 10-6 (1 in 1,000,000) increased incidents of cancer above background)). Because of the risk being within the acceptable risk range, remediation of these chemicals in surface water and sediment is not warranted.

Remediation of the ground water is warranted based on the risk to human health from ingesting and contacting contaminated ground water. Remediation of soil is warranted based on the potential for contaminants in the soil to be transported to the underlying ground water. Actual or threatened releases of hazardous substances from OU-1, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, and the environment.

An ecological risk evaluation of OU-1 was based on a combination of data and literature reviews, field and laboratory analyses, analyte evaluation and screening, and preliminary risk screening. A variety of animal species may live, forage, or nest in OU-1 habitats. These species include various types of invertebrates, amphibians, birds, and mammals. Terrestrial vegetation and soil faunal communities do not reveal characteristics that indicate chemical-related impacts. This finding is consistent with the relatively low levels of contaminants in the soil.

Because of the altered natural environment at OU-l, rare, threatened, or endangered species are unlikely to utilize the area for more than brief, periodic habitat. Due to the low levels of contaminant concentrations and the identified exposure pathways, the contaminants do not pose an unacceptable risk to these species. In addition. the limited contact these species would have with the OU-1 area ensures unacceptable risk to a single individual will not occur.

3.2.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU. A new FPTA was constructed to the northeast of the OU in 1994. However, this new FPTA construction was not done as a remedial response action.

3.3 OPERABLE UNIT 2 LANDFILL 1 AND LANDFILL 6

3.3.1 Physical Setting

Surface topography at Landfill No. 1 generally slopes in a southerly direction from Kenney Road to the southern boundary of EAFB (Figure 3-7). Some hummocky topography and small surface depressions are visible across the area. A series of east-west trending depressions are clearly visible in aerial photographs of the area and are assumed to be the surface reflection of historical trench and fill operations. The topography of Landfill 1 reflects minimal relief with a gentle southeast slope (approximately 5 to 10 degrees) toward the small southeastward flowing stream. An elongated, flat-top mound is present near the western boundary of the landfill. This mound is oriented in a north-south

direction and is about 18 feet wide, 243 feet long, and stands about 1.5 to 2.0 feet above the surrounding topography. Parallel to the east edge is a ditch-like depression extending the full length of the mound.

Surface water that flows adjacent to and through Landfill 1 originates from Pond 001. Pond 001 is located upstream immediately northwest of Landfill No. l, across Kenney Road. Pond 001 is elongated in shape, approximately 720 feet long and 180 feet wide at the widest point on the south end of the Pond. It collects surface water drainage from north and west of the alert apron. Precipitation that falls on the edge of the alert apron is also discharged to Pond 001. Outflow from the pond empties to a small unnamed, southeasterly flowing stream located along the western boundary of the landfill. The stream follows a ditch that is approximately 20 feet wide and 15 feet deep. The ditch channels the stream along the western boundary of Landfill 1 and eventually off-Base through a cow pasture south of OU-2. Stream flow measurements were conducted on 21 July 1993, at OU-2 surface water sample locations on this stream. The stream flow measurements indicate that this unnamed stream had an average discharge of approximately 1.14 cubic feet per second (CFS). The OU-2 stream flow measurements were measured during peak flow of a rain event. This stream ultimately discharges into Box Elder Creek.

Landfill No. 6 is situated on a hillside that slopes to the east and resides just west of Pool 002 and northeast of Landfill No. 1 (Figure 3-7). The landfill boundary presented in Figure 3-7 is based upon fill material encountered in borings drilled during the 1993/94 RI. No landfill material was encountered under the asphalt parking lot at the top of the hillside. Therefore, the approximate boundary of Landfill No. 6 identified during the RI is east of the boundary depicted in Installation Restoration Program (IRP) reports as presented in Figure 3-7.

Surface drainage from Landfill No. 6 is toward the east to a small surface water body designated Pond 002. Pond 002 is semi-circular in shape, approximately 120 feet long, and 100 feet wide. This pond also collects surface water runoff from the western one-half of the runway and adjacent operations areas, and from storm water drains located within the alert apron. Outflow from Pond 002 empties to a small, ephemeral stream that drains to the south and ultimately to Box Elder Creek. Stream flow measurements were conducted on 21 July 1993 at OU-2 surface water sample locations on this stream. The stream flow measurements indicated that this small ephemeral stream had a discharge of approximately 0.24 cfs.

3.3.2 Land and Resource Use

There is very little natural undisturbed surface soil across OU-2, since the area has been used for landfill operations. Landfill No. 1 covers a large portion of the central and southern parts of OU-2 and the surface material in this area is predominantly comprised of cover soil. Construction debris (concrete, reinforcing bar, brick) is visible in small areas in the northwest corner of the landfill. Along the western landfill edge, adjacent to the ephemeral stream, twisted metal rods and pipes, concrete with reinforcing bars, flattened drums, and other debris are exposed.

The western edge of Landfill No. 6 is covered by an asphalt parking lot, while toward the east, Landfill No. 6 has been covered with soil. A gravel road runs from Kenney Drive to the small dam at Pond 002 and winds through the eastern edge of Landfill No. 6.

During the RI a variety of habitat features were observed at OU 2, many of which had been altered by human activities such as past landfill operation, maintenance, and grazing. In spite of these activities, habitat still existed that would attract animal species that would be potential chemical receptors. Since

the landfill has had a soil cover placed and reseeded as part of the remedial action, these grass habitats have been improved.

Wetlands consisting of a retention pond and drainageway are located in the west part of OU-2. These wetlands are part of a larger Base storm water system, which offers shelter, foraging and nesting habitat for a variety of species. The U.S. Fish and Wildlife Service National Wetland Inventory Map (NWI) classifies the wetland community types present on OU-2 as Palustrine Emergent Temporarily Flooded (PEMA) and Palustrine Aquatic Bed Semipermanently Flooded (PABF).

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or fauna species classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

The construction of the landfill covers for this OU is complete. Access is restricted to Base personnel and contractors responsible of the maintenance of the cover and operation of the remedial systems. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

3.3.3 History of Contamination

Landfill No. 1 was active from the early 1940s to 1964 and was used to dispose of a variety of wastes including Base refuse, incinerator ash, sludge, oil, possibly liquid industrial wastes, and hardfill debris.

Aerial photo analysis conducted by the EPA from historical photos (1938 to 1990) indicated the types of disposal practices at Landfill No. 1. Through interpretation of these photographs, landfill materials appear to have been placed in trenches in the eastern two-thirds of the landfill. The western third of the landfill appears to have been used to dispose of primarily hardfill materials. This is evidenced by the presence of exposed rubble piles in this area. Hardfill has been placed along the embankment of the drainage channel in the western portion of the landfill. Other disposal practices at Landfill No. 1 include open burning of refuse and debris.

Landfill No. 6 was used from 1962 to 1965 and primarily received general Base refuse. Waste oil, fuel, and solvents may also have been disposed of at this location. No direct physical evidence of these chemicals was found at Landfill No. 6 during the 1993/1994 remedial investigation (RI) field activities.

Within OU-2, soils contained chlorinated VOCs, BTEX, and polynuclear aromatic hydrocarbons (PAHs), (Figure 3-8). The reported VOCs and BTEX chemicals represent the residual of fuels and solvents used for aircraft and vehicle operation and maintenance at EAFB. The PAHs are the residual of incomplete combustion of motor fuels and were not a specific chemical used at EAFB. All but one of the reported concentrations in soil was below the 10^{-6} risk based level calculated for excess carcinogenic risks. Samples from monitor wells installed in the interior of Landfill No. 1 indicated the presence of TCE and DCE in five samples at maximum concentrations of 14 ug/L and 19 ug/L, respectively.

JP-4 contamination caused by a leak in a fuel line was identified along the southern boundary of OU-2. This JP-4 contamination is being remediated under the SDDENR petroleum release program.

OU-2 is bounded on the west by a surface water drainage channel. This channel contains areas of wetlands. Remedial construction activities at the OU resulted in some reworking of soil and drainage channel relocation in the wetland areas. Replacement wetlands were constructed near other Base lakes located near the center of EAFB.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-2. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6} (The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300)). Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). Based on human health risk protocols established by EPA, if the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The risk assessment for OU-2 indicated that the future carcinogenic risk slightly exceeded the acceptable range only from ingestion of ground water containing arsenic and beryllium. Arsenic and beryllium are considered naturally occurring at OU-2. All other current and future quantified carcinogenic risks were within the acceptable risk range.

Part of the remaining site risk includes risks from exposure to surface soil contaminants. The chemicals, which contributed the majority of risk in the soil, were PAHs. Benzo(a)pyrene, a PAH, is the primary contaminant identified in the risk assessment as contributing to risk from soils. However, only one surface soil and two subsurface soil samples actually contained concentrations of benzo(a)pyrene that are of concern. Due to the heterogeneity of the landfill contents, uncertainty is associated with the calculated risk values for the surface soil.

Benzo(a)pyrene was also the primary chemical contributing to carcinogenic risk in the sediments at OU-2. Five of seven sediment samples contained benzo(a)pyrene at concentrations that are of concern. However, the results of the risk assessment indicate that risk due to exposure to contaminants in sediments at OU-2 is within the acceptable risk range. It is typical for compounds in the surface soil to wash into adjacent drainages and to settle or become trapped in the drainage areas. Remedial action for the drainage areas outside of the landfill boundaries is not warranted.

The risk assessment for OU-2 indicated that the only non-carcinogenic risk resulting in an HI above 1.0 was from ingestion of ground water containing arsenic. Arsenic detected in samples throughout the Base is considered to be naturally occurring.

Results of the risk assessment indicated that surface water was not a media of current concern, because the chemicals detected in the ground water, which contributed to excess risk, are considered to be naturally occurring. Therefore, remedial action is not warranted for the ground water and surface water at this time.

Remedial action was considered warranted for the landfills based on the potential risk to human health from future releases of hazardous substances from the landfills. Contaminants in the landfills may leach

downward to contaminate the underlying ground water. Off-Base residents may then ingest or come in contact with the contaminated ground water. Also, the surface of the landfills may erode, thus exposing Base personnel doing maintenance work to disposed hazardous substances.

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or fauna species classified as rare, threatened, or endangered in South Dakota were observed on EAFB. In terms of ecological value OU-2 represents a highly disturbed environment dominated by the adjacent runway and alert apron. Some habitats do exist in the area including grass fields, weedy old fields, tress and wetlands interspersed among the disturbed areas. The tiered Ecological assessment did not identify anv chemical related impacts and a Tier III assessment was considered unwarranted.

3.3.4 Initial Response

Two removal actions were completed at this OU. A site in the southwest corner of Landfill 1 identified during RI geophysical investigations was excavated in 1997. This location contained remnants of chemical weapons training materials and low-level radioactive waste material. The identified material was excavated and moved off Base for disposal at a licensed waste disposal facility.

3.4 OPERABLE UNIT 3 LANDFILL 2

3.4.1 Physical Setting

The area west of Landfill 2 slopes very gently to the south, whereas the area east of Landfill 2 slopes to the east where a dendritic pattern of ephemeral drainages has dissected the area. The southern drainage leads to Box Elder Creek. The eastward drainage at OU-3 is part of an overall northern sloping dendritic pattern that drains toward ephemeral drainages that lead to Elk Creek. OU-3 is currently undeveloped and is dominated by relatively undisturbed grassland. Some exposed rubble was evident in full trenches in the northern portion of the OU at the time of the RI.

Water uses designated for the streams include irrigation. wildlife propagation, and livestock. In addition, the Elk Creek designation includes limited contact recreation.

The available habitat on OU-3 is dominated by relatively undisturbed grassland. OU-3 differs from most of the other operable units in that none of the site is developed. There are no buildings, parking areas, or paved roads within the OU. Trench-and-fill activities have physically altered the vegetation on a small portion of OU-3, but the majority of the OU is relatively undisturbed grassland that remains attractive to animal species that would be potential chemical receptors.

No wetlands were identified on the OU. That is, no standing or flowing water existed, and dominant plant species were not hydrophytic in any part of the OU.

3.4.2 Land and Resource use

OU-3, located in the northeast portion of EAFB, consists of Landfill 2, an approximately one acre site, the four identified trenches to the north and two disturbed soil areas in the southeast and southwest corners (Figure 3-9).

The area west of Landfill 2 slopes very gently to the south, whereas the area east of Landfill 2 slopes to the east where a tree-like pattern of intermittent drainages has dissected the area. The southern drainage

leads to Box Elder Creek. The eastward drainage at OU-3 is part of an overall northern sloping tree-like pattern that drains toward intermittent drainages, which lead to Elk Creek. OU-3 is currently undeveloped and is dominated by relatively undisturbed grassland.

The placement of the landfill cover is completed at this OU. The OU is closed to access. except for Base personnel and contractors responsible of the operation of the remedial systems. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

3.4.3 History of Contamination

The landfill was active for approximately one year (1964-1965) until operable concerns with trash containment ended its use. Methods used to dispose of the refuse included surface filling of a low-lying area (fill area) and trench and fill operations. Combustible trash, described as shop wastes, was burned daily in a burn pit. Four trenches located north of the fill area were used for the disposal of metal and industrial and household refuse. Possible burial sites were identified in the August 24, 1971, aerial photo, but the trench origination dates are not known. Some metal debris was exposed at OU-3 and may have been the result of surface disposal of metal waste. Areas of disturbed soil in the southwestern and southeastern corner of OU-3, which may have been dump areas, were also identified in historical aerial photographs of EAFB.

A sign had been located within the boundary of OU-3 indicating a missile, disposal/burial site (USAF, 1988). The missile disposal site is basically scrap metal salvaged from a test flight and is not a source of chemical release to the environment. According to the USAF, the missile dates from a test firing in the mid-1960s. Information on the missile is still classified at this time.

Soil and soil vapor samples from OU-3 indicated the presence of VOCs, BTEX, methane (soil vapor only) and semi-volatile organic compounds (SVOCs) (soil only). The calculated carcinogenic risk level for surface soil was 1×10^{-6}, due to the presence of SVOCs. This was considered within the acceptable range. The reported VOCs and BTEX compounds are residual from fuels used at EAFB and from solvents used in maintenance and repair of aircraft and other vehicles.

The most commonly reported compound, in soil vapor samples, in the trench-area samples was tetrachloroethylene (PCE) with a maximum concentration of 0.192 parts per million (ppm) near the middle part of the western trench. Toluene and xylenes were also reported in soil vapor samples, at concentrations up to 38.23 ppm, total reported benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations up to 99.53 ppm, and trichloroethylene (TCE) at concentrations up to 0.297 ppm. Methane was reported at concentrations up to 50,722 ppm, primarily in samples for which other compounds were also reported. The lower explosive limit for methane is 50,000 ppm, with an upper explosive limit of 150,000 ppm (Figure 3-10). The PCE and TCE identified at this OU are the residual left from equipment maintenance and grease stripping operations related to aircraft and vehicle repair and maintenance.

Toluene was reported in two samples collected from the burn-pit area at concentrations of 0.53 ppm and 1.21 ppm, respectively. Xylene, methylene chloride, Dichloroethene (DCE), and TCE were reported in samples at concentrations of 1.10 ppm, 0.57 ppm, 1.14 ppm, and 0.003 ppm, respectively. TCE was also reported in a sample at a concentration of 0.014 ppm.

TCE was reported in six samples collected from the southwest corner of OU-3 at a maximum concentration of 0.169 ppm. One sample had a reported total DCE concentration of 0.264 ppm. Soil samples contained acetone, acetonitrile, VOCs (DEC was reported as high as 12.0 ug/L). Jet fuel concentrations as high as 170 mg/kg, SVOCs, and pesticides.

Ground water samples indicated the presence of chlorinated VOCs and petroleum constituents. The calculated carcinogenic and non-carcinogenic risks for ground water exceeded the acceptable carcinogenic and non-carcinogenic risk ranges. In the trench area, nine VOCs were reported above quantitation limits for ground water samples. Vinyl chloride was reported in two of the samples (11.0 micrograms per liter [ug/L] and 4.2 ug/L), and 1,2-dichloroethane was reported in one sample at 17.0 ug/L. Downgradient from the fill area, VOC samples were obtained from three monitoring wells, but because of insufficient water, no other constituents were analyzed in one of the wells. A total of six VOCs were reported: PCE, TCE, total 1,2-dichloroethene, benzene, ethylbenzene, and xylenes, Figure 3-11.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-3. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by $1 \times 10^{-4}$to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The risk assessment for OU-3 indicated that the current and future total carcinogenic site risk, calculated using average exposure assumptions, is within the acceptable risk range for the residential scenario. Total current and future carcinogenic risk calculated using the RME exposure assumptions is greater than 1×10^{-4}. The majority of the total carcinogenic site risk for the residential scenario is from exposure to VOC and arsenic in the ground water. The current and future non-carcinogenic risk is due to naturally occurring selenium in ground water. However, due to the heterogeneity of the landfill contents, great uncertainty is associated with the calculated risk values.

Based on the OU-3 risk assessment, the calculated carcinogenic and non-carcinogenic risks for ground water is 2×10^{-4} and 4.8, respectively. The calculated carcinogenic risk level for surface soil is 1×10^{-5}, due to the presence of SVOCs. This is within the acceptable risk range. Based on this calculated acceptable risk, and the low concentrations of contaminants detected in surface soil samples, remediation is not warranted for surface soil as part of OU-3.

Remedial action was warranted for the landfill based on the uncertainty associated with the calculated risk values. Based on the OU-3 risk assessment, the calculated carcinogenic and non-carcinogenic risks for ground water exceed the acceptable carcinogenic and non-carcinogenic risk ranges. However, remediation is not warranted for ground water at OU-3. The sporadic reported concentrations and lack of localizations of contaminants detected in ground water at OU-3 result in the risk assessment model

estimates developed for this site being highly conservative and therefore present uncertainty for interpretation of risks for these contaminants within an OU-wide context. The data do not support the existence of plumes of these contaminants, therefore monitoring of the ground water will provide for the protection of the environment and human receptors as degradation of the COC (vinyl chloride) is monitored overtime.

The potential sources for the chemical COCs at OU-3 are the landfill and trenches, which cover about one acre. The Tier I and II ecological risk evaluations determined that this area was too small to present a significant ecological risk and the site was not recommended for a Tier III assessment.

3.4.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU.

3.5 OPERABLE UNIT 4 LANDFILL 3

3.5.1 Physical Setting

OU-4 consists of Landfill No. 3, which is approximately 35-40 acres in size and is located in the southwestern corner of EAFB (Figure 3-2). The topography at OU-4 is fairly level, with a slight slope toward the south and east, and a few broad, shallow depressions. The western portion of the OU slopes gently toward the west. A series of east-west trending depressions are visible on aerial photographs, and are assumed to be the surface reflection of historical trench and fill operations.

A shallow aquifer has been identified at depths of 10 feet to 50 feet beneath the ground surface at EAFB. The top of the shallow aquifer at OU4 varies seasonally, but is generally 14 ft to 32 ft below the ground surface. This ground water is classified as having a beneficial use as a drinking water supply suitable for human consumption (ARSD Chapter 74:03:15, Ground water Quality Standards). The shallow aquifer may also discharge to the surface. However, no known seeps or springs were identified at OU-4.

Deeper bedrock aquifers also exist beneath EAFB. These deeper aquifers are separated from the shallow aquifer by 800 feet of low-permeability clays and silts. In the past, EAFB utilized these deeper aquifers for its water supply. Presently, EAFB obtains its potable water from the Rapid City Municipal Distribution System.

3.5.2 Land and Resource Use

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or fauna species, classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

Operable Unit (OU) 4 is predominately grassland habitat, much of which has been disturbed by human activities, such as past landfill operation and current maintenance. Despite the disturbance, habitat still exists that would attract animal species that would be potential contaminant receptors. Introduced grasses dominate existing vegetation on OU-4. Crested wheatgrass (*Agropyron cristatum*) covers most of the OU-4 investigative area, including the area over the former landfill. The landfill covers approximately half of the OU, but the only remaining visual evidence of the landfill is the rough and uneven terrain resulting from trench and fill activities. Small patches of other grasses, such as smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*), are also present within the crested wheatgrass field. A number of forb species, such as

yellow sweet clover (*Melilotus offcinalis*), skeletonweed (*Lygodesmia juncea*), purple coneflower (*Echinacea angustifolia*), scurfy pea (*Psoralea tenuiflora*), and cowboy's delight (*Spharalcea coccinea*), are present as well.

Construction of the landfill cover at this OU is complete. Access to the OU is restricted to Base personnel and contractors responsible of the maintenance of the cover and for the completion of long term ground water monitoring and operation of the remedial systems. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

3.5.3 History of Contamination

The landfill was primarily active between 1965 and 1976 as a trench and fill operation. Disposal trenches were approximately 13 to 15 ft deep. A recent examination of 1946 and 1952 aerial photographs of EAFB indicated that some landfill activity may have occurred prior to 1965. Also records indicate that one open trench was used for disposal of construction demolition debris during the mid-1980s. Digested wastewater treatment plant biosolids was also added to the landfill at this time. Solid waste generated onBase has been disposed of by contract at an off-Base sanitary landfill since 1976.

Shop wastes (liquids and paints), industrial sewer sludge and oils, and miscellaneous refuse were placed in Landfill No. 3. During the mid-1970s, a gravel-filled waste-oil pit was operated in the southwest corner of the OU for about one year. These wastes are thought to be the source of the VOCs and SVOCs identified during the RI. The contents of approximately 100 55-gallon drums containing waste oil and fuel were placed in the w aste-oil pit. Prior to 1982, the southwest corner of OU-4 was also used as a staging area for 55-gallon drums containing waste oil and fuel. Recently, the southwest corner of OU-4 was used to stage asphalt rubble. The asphalt rubble was removed in the fall of 1993. The exact locations of the waste pit and drum staging area are not known, but are presumably in the vicinity of the former asphalt waste pile area. During 1982 and 1983, OU-4 was used as a disposal site for soil containing Pramitol, a herbicide, and sodium chromate, a launch facility coolant.

Soil at OU-4 contained elevated VOCs, semi volatile organic compounds (SVOCs), and pesticides within the EAFB boundary (Figure 3-11). Ground water contained chlorinated VOCs, SVOCs, and pesticides (Figure 3-12). Contaminated ground water within this OU moved from the landfill, (Figure 3-13), located within the original Base boundaries, to an adjacent area within the OU, which is now owned by the Air Force. The VOCs and SVOCs were residuals from shop wastes disposed at the OU. The pesticides residuals are the result of normal ground keeping use on EAFB.

Sixteen separate VOCs were reported in soil samples from OU-4. Toluene was the only reported VOC in surface soil samples. Acetone, toluene, ethylbenzene, xylenes, octamethylcyclotetrasiloxane, trichloroethene (TCE), and 1,2-total-dichloroethene were the most commonly reported VOCs in subsurface soil samples. Four soil samples taken from locations within Landfill No. 3 contained PAH, o-cresol and p-cresol. Benzo(a)pyrene was reported in three surface soil samples.

Twenty different pesticides and two PCBs were reported in soil samples. The highest frequency of reported pesticides was from surface soil samples collected within Landfill No. 3. Reported pesticides are believed to be a result of normal pesticide application practices on the surface, rather than disposal of waste product. No specific source was identified in Base records for the PCBs.

Eight inorganic compounds were reported above background in OU-4 surface soil samples. Calcium and magnesium were the inorganic analytes most frequently reported above background concentration. Sixteen inorganic analytes were reported above background levels in OU-4 subsurface soil samples. Lead, silver, and zinc were reported at 4, 250, and 18 times, respectively, above the background range in one subsurface sample. These inorganic elements are from naturally occurring materials contained in the Black Hills Soil Complex and base rock materials.

Reported dioxin/furan included: 2,3,7,8-tetrachlorodibenzofuran; 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin and furan; and octachlorodibenzo-p-dioxin and furan. The international toxic equivalents were below the 1,000 picograms per gram (pg/g) level of concern for residential soil.

One sediment sample was taken during the 1993 RI. This sample was taken from an off-Base ephemeral stream channel downgradient of OU-4. Reported analytes included acetone in the duplicate analysis only, eight separate PAH compounds, three pesticide compounds, and inorganic compounds.

TCE and total dichloroethene (DCE) were the most frequently reported VOCs in ground water samples. TCE, vinyl chloride, and 1,2-dichloropropane were reported in samples taken from the shallow aquifer at or above the Maximum Contaminant Level (MCL). Sample results from OU-4 monitoring wells indicate chlorinated hydrocarbons were reported in ground water samples from four general areas. The first area extends from the center of Landfill No. 3 south past the Base boundary approximately 2,000 feet. The second area is in the southwestern corner of the landfill, and extends off-Base to the south and southwest. There is some indication that these two areas may be interconnected. The third area is an isolated occurrence in the northeast corner of the OU. A fourth area is in the vicinity of the control tower.

Nineteen different SVOCs analytes were reported in ground water samples from OU-4. Bis(2-chloroethyl)ether and 1,4-dichlorobenzene were the most frequently reported SVOCs in ground water samples. 1,2,4-trichlorobenzene was reported once above the MCL of 70 ug/L. Pentachlorophenol was reported once at 1 ug/L, equal to the MCL.

Fourteen different pesticides were reported in eight ground water samples. Aldrin, alpha-BHC, beta-BHC, heptachlor, and heptachlor epoxide were the most frequently reported pesticides in OU-4 ground water samples. The highest reported pesticide value was for prometon, which was reported once at a concentration of 0.95 ug/L.

Seventeen inorganic compounds exceeded background ranges in ground water samples. Antimony, cadmium, manganese, lead, nickel, and selenium were reported at values that exceeded the MCL in at least one sample. However, antimony, manganese, and selenium were also reported in background samples above the MCL, and are believed to naturally occur at higher concentrations in the area.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-4. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The risk assessment for OU-4 indicated that the chemical, which contributed the majority of the risk in the soil, was benzo(a)pyrene [a polynuclear aromatic hydrocarbon (PAH)]. However, only three of five samples had reported benzo(a)pyrene concentrations in excess of the reasonable maximum exposure (RME) 10^{-6} risk range. None of the sample concentrations exceeded the central tendency/average risk range. However, due to the heterogeneity of the landfill contents, uncertainty is associated with the calculated risk values for the surface soil.

The following compounds were identified in the risk assessment as contributing to unacceptable current and future risk (risk drivers) in ground water on-Base: vinyl chloride, 1,1-DCE, TCE, n-nitroso-di-n-propylamine, bis(2-chloroethyl)ether, 1,4-dichlorobenzene, aldrin, alpha-BHC, and heptachlor. In addition, 1,2,4-trichlorobenzene, cadmium, and lead were reported above the MCL in on-Base ground water samples. Total-1,2-DCE was reported above the MCL for cis-1,2-DCE in on-Base ground water samples.

Vinyl chloride, 1,1-DCE, TCE, 1,2-DCA, and alpha-BHC were identified as current and future risk drivers in off Base ground water. In addition, lead and total-1,2-DCE were reported above the MCL in off-Base ground water samples.

Remediation of the ground water is warranted based on the risk to human health from ingesting and contacting contaminated ground water. Remedial action is also warranted for the landfill based on potential risk to human health from future releases of hazardous substances. If not remediated, contaminants in the landfill may leach downward to contaminate the underlying ground water. Off Base residents may then ingest or come in contact with the contaminated ground water. Also, the current surface of the landfill may erode, thus exposing off-Base residents to contaminants in both surface water and air. Due to the potential heterogeneity of the waste materials present within the landfills, a complete characterization of waste materials present was not possible during the RI. This adds a degree of uncertainty to the risk assessment for the landfill contents. Rather than attempting to fully characterize landfill contents and gain more certainty in the risk assessment, the Air Force utilized guidance developed by EPA titled *Presumptive Remedy for CERCLA Municipal Landfill Sites* (OSWER Directive 9355.0-49FS). The presumptive remedy for landfills is containment (capping) of landfill contents. Using the presumptive remedy strategy, a quantitative risk assessment is not necessary to evaluate whether the containment remedy addresses all exposure pathways and contaminants potentially associated with a landfill. Rather, all potential exposure pathways can be identified using the conceptual site model and compared to the pathways addressed by the presumptive remedy. Containment of the landfill contents addresses exposure pathways and risks normally associated with landfills. The contaminant exposure pathways for the potential risks associated with the landfill contents at OU-4 include (1) direct physical contact with the landfill contents and (2) consumption or contact with ground water that may become contaminated.

In terms of ecological value OU-4 represents area that has been highly disturbed. The area has overgrown with a wide variety of grasses and herbaceous plants. The Tier I and II ecological risk assessment identified a number of invertebrates, small mammals, birds, larger mammals, and reptiles that may forage, live or nest in the area. Terrestrial vegetation and soil faunal communities did not reveal patterns indicating chemical-related impacts, a Tier III investigations was considered unwarranted.

3.5.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU.

3.6 OPERABLE UNIT 5 LANDFILL 4

3.6.1 Physical Setting

OU-5 consists of Landfill 4 and approximately 50 adjacent acres near the northern perimeter of EAFB. Landfill No. 4 is approximately a 10-acre area located at the northern end of Scott Drive. Topographically, the southern portion of the landfill slopes slightly to the north (Figure 3-13). The northern portion of Landfill No. 4 slopes steeply to the north-northeast and the western portion of the OU slopes toward the west. Several incised valleys exist to the north and west of Landfill No. 4. These valleys carry storm water runoff off-Base, north and northwest of OU-5 into several unnamed ephemeral tributaries of Elk Creek. Two ephemeral ponds along an erosional gully were identified during the field survey. The "ponded" areas are within the natural drainage way where the water source is surface runoff. The erosional gully originates on the steep face of Landfill No. 4. It collects surface nmoff from the surrounding hilly terrain and carries it to the north, off the OU and the Base. Southwest of the landfill, the topography is fairly level with a slight rise associated with a Base perimeter service road. Landfill No. 4 has exposed fill areas throughout most of the former disposal areas.

3.6.2 Land and Resource Use

Crested wheatgrass fields and mixed grass prairie dominated the habitat on OU-5 during the RI. OU-5 differs from the majority of the operable units in that none of the site is developed. There are no buildings, parking areas, or paved roads within the OU. Because of the lack of development, over half the OU contained grassland that was attractive to animal species that would be potential receptors.

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or fauna species classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

The only wetlands identified on OU-5 are part of an isolated drainage system associated with the erosional gully. They consist of two small ephemeral ponds located in depressions along the erosional gully. The ponds are highly degraded and are unlikely to provide any wildlife habitat. Both ponds are heavily used by cattle; compacted soils and trampled vegetation were common around the ponds. In addition, both ponds were scattered with debris from the landfill, such as tires, rubble, and scrap metal.

Remedial construction activities at this OU have been completed. Accessed to the site is restricted to Base personnel and contractors responsible of the maintenance of the landfill cover and long term monitoring of ground water. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

3.6.3 History of Contamination

Waste was disposed of at OU-5 from the 1940s through 1990. This landfill was used primarily for the disposal of construction demolition and hardfill materials: however, reports and visual observations from installation restoration program (IRP) studies noted that this site was also used for general refuse and drum disposal. The Base Commander terminated waste disposal activities at this landfill after 1990.

Polynuclear aromatic hydrocarbons (PAHs) at estimated values below the sample quantitation limit (48 ug/kg to 250 ug /kg) and JP-4 jet fuel, in one surface soil sample (SB930502) at 190 mg/kg, were reported in soil samples collected from OU-5 (Figure 3-14). Jet fuel was also reported at a concentration of 100 ug/L in one ground water sample collected during the investigation (Figure 3-15). The PAH compounds are attributed to the incomplete combustion of jet and motor vehicle fuels.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-5. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. the acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

Part of the site risk present at OU-5 includes risk from exposure to surface soil contaminants from within the landfill. In addition, due to the heterogeneity of the landfill contents, there is some uncertainty associated with the calculated risk values for the surface soil. The risk assessment for OU-5 indicated that the carcinogenic current and future risk was within the acceptable risk range of 1×10^{-4} to $1 \times 10^{-6,}$ and there were no non-carcinogenic risks resulting in an HI above 1.0.

Results of the risk assessment indicated shallow ground water and surface water were not media of current concern. Therefore, remedial action is not warranted for the ground water and surface water at this time. The ground water at OU-5 will still be retained as part of the Base-wide ground water evaluation for OU-11.

Remedial action is warranted for the landfill based on the potential risk to human health from future releases of unidentified hazardous substances in the landfill. Contaminants in the landfill may leach downward to contaminate the underlying ground water. Off-Base residents may then ingest or come in contact with the contaminated ground water. Also, the surface of the landfills may erode, thus exposing off-Base residents to contaminants in both surface water and air. Due to the potential heterogeneity of the waste materials present within the landfill, uncertainty is associated with the calculated risk values for surface soil.

The ecological evaluation of OU-5 was based on a combination of data and literature reviews, field and laboratory analyses, analyte evaluation and screening, and preliminary risk screening.

A variety of potential receptors were identified that could nest and/or forage in OU-5 habitats. These range from the soil fauna identified with pitfall traps to aquatic invertebrates in the ephemeral ponds to birds and mammals. Those species preferring grassland and tolerant of disturbed, weedy areas would be expected to be more common. Rare, threatened, or endangered species are unlikely to utilize OU-5 for more than very transitory habitat.

Terrestrial vegetation and soil fauna communities at OU-5 were statistically different from those at an off-Base reference area. While not confirming effects of elevated chemicals (differences may in fact have been due to differences in physical disturbance), the differences were sufficient to conduct a Tier II evaluation (based on terrestrial vegetation) and then a preliminary risk screen (based on soil fauna data).

The preliminary risk screen identified the following analytes as chemicals of concern at OU-5: silver, endrin, heptachlor epoxide, arsenic, beryllium, and mercury. The metals are considered naturally occurring elements in the Black Hill Area soil complex, the pesticides are thought to be residuals from on-Base pest control practices.

The landfill that is a potential source of the COCs at OU-5 covers an area of about ten acres. This is considered too small to present significant ecological risk, and an OU-specific Tier III assessment was not completed. However, the identified COCs were carried over for evaluation in a Basewide ecological risk assessment.

3.6.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU.

3.7. OPERABLE UNIT 6 LANDFILL 5

3.7.1 Physical Setting

The topography of OU-6 is characterized by an east-west drainageway and a north-south stream. The east-west drainageway is located in the southern portion of OU-6, and drains surface water off of OU-6 to the southeast. It also includes a storm sewer discharge. The stream along the eastern (north-south drainage) boundary of OU-6 drains surface water off-site to the south. This drainage is fed by Gateway Lake, located approximately 1,000 ft upgradient of OU-6 and by discharge from the Base WWTP. This drainage collects approximately two-thirds of the storm water runoff from the Base. One of the more important wildlife habitat features on OU-6 is the wetlands vegetation associated with these drainages.

3.7.2 Land and Resource Use

Two distinct types and areas of fill material were found at OU-6. The first type of fill material was clean fill used on the eastern portion of the OU, probably during construction of the golf course, and consists of re-worked soil and organic material. The organic material was described in the field as black organic humus type material resembling WWTP sludge material and plastic, and may have been used as a soil amendment when the golf course was built. The second type of fill material is landfill material, which consists of construction debris and demolition debris. Construction and/or demolition debris consists of broken concrete, broken brick, asphalt, and wood.

Field survey s were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or fauna species classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

Remedial actions at this OU have been completed. Access to the area is restricted to Base personnel and contractors responsible of the maintenance of the landfill cover and for long term monitoring activities. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

3.7.3 History of Contamination

The landfill at OU-6 (Landfill No. 5), located in the southeastern corner of the Base (Figure 3-2), was active from 1960 to 1980 and primarily used to dispose of construction and demolition debris. Hardfill (i.e., concrete, asphalt) was placed along the rail line to stabilize erosion. In addition, reports state digested sewage sludge, miscellaneous refuse, and possibly shop wastes may have been disposed of at this landfill (USAF, 1985). However, no direct physical evidence of miscellaneous refuse or industrial/shop waste has been found at OU-6.

Polynuclear aromatic hydrocarbons and pesticides were reported in soil samples collected from OU-6 (Figure 3-16). Levels of VOCs and metals contaminants observed in the ground water at the site were below Maximum Contaminant Levels (MCLs) or considered to be representative of background levels (Figure 3-17). PAHs are the residuals of incomplete motor and jet fuel combustion. The pesticides are residual for normal grounds keeping use on Base.

Acetone, pentane, styrene, benzene, toluene, xylene, naphthalene, bis (2-ethylhexyl) phthalate, and heptachlor epoxide were reported in at least 1 sample collected from surface water locations during the RI investigation.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-6. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one. The contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The human health risk assessment evaluated potential effects on human health posed by exposure to sources and/or releases associated with Landfill No. 5. The assessment considered the possibility of multi-media sources including ground water, soil, surface water, sediment and air. Results of the baseline risk assessment indicated shallow ground water and surface water were not media of concern. Identified risk driver chemicals of concern for OU-6 included: PAH in surface soil, manganese in soil, and arsenic in sediment. The calculated current and future carcinogenic risk for OU-6 was within EPA's acceptable range of 10^{-4} to 10^{-6}.

A variety of potential receptors were identified that may live, forage or nest in OU-6 habitats. These range from benthic invertebrates and amphibians in the drainage channels to birds and mammals. Terrestrial vegetation and fauna communities did not show patterns indicating elevated chemical exposure-related impacts. This finding was considered consistent with the relatively low levels and limited distribution of elevated chemical concentrations in soil, and the active and disturbed nature of the site observed during the RI. Tier III investigations were not completed at this site but the COCs were carried over to the Basewide Tier III assessment.

OU-6 is bounded on the east and south side by a surface water drainage channel. This channel contains areas of wetlands. Remedial construction activities at the OU resulted in some reworking of soil and drainage channel relocation in the wetland areas. Replacement wetlands were constructed near other Base lakes located near the center of EAFB.

3.7.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU. A new FPTA was constructed to the northeast of the OU in 1994. However, this new FPTA construction was not done as a remedial response action.

3.8 OPERABLE UNIT 7 WEAPONS STORAGE AREA

3.8.1 Physical Setting

The topography at OU-7 gently slopes toward the west and southwest away from the high plateau located in the northeastern corner of the WSA. Surface-water drainage from OU-7 generally flows into drainages directed to Box Elder Creek. Some surface water flows off-Base to the east, northeast, and southeast of the OU.

OU-7 surface geology generally consists of a surface layer of silty clay, approximately 3 to 6 feet thick, underlain by a layer of silty sandy gravel to clayey gravel, 4 to 27 feet thick. these layers overlie the Pierre Shale Formation. Depth to shallow ground water at OU-7 ranges from approximately 10 to 31 feet.

The shallow aquifer at EAFB is considered a potential drinking water source and possibly discharges to the surface. The ground water is classified as having a beneficial use as a drinking water supply suitable for human consumption (S.D. Chapter 74:03:15, Ground water Quality Standards).

Deeper bedrock aquifers also exist beneath EAFB. These deeper aquifers are separated from the shallow aquifer by 800 feet of impermeable clays and silts. In the past, EAFB utilized these deeper aquifers for its water supply. Presently, EAFB obtains its potable water from the Rapid City Municipal Distribution System.

3.8.2 Land and Resource Use

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or fauna species classified as rare, threatened, or endangered in South Dakota w ere observed on EAFB.

Remedial actions implemented at the OU consisted of the application of institutional controls and ground water monitoring. A removal action was completed at the OU to remove low level radiological waste

materials buried at this OU. The material was removed and disposed of according to current EPA and Nuclear Regulatory Commission requirements.

3.8.3 History of Contamination

OU-7 includes the Low-Level Radioactive Waste Burial (LLRWB) site located in the Weapons Storage Area (WSA) at the northern end of the Base. The WSA covers approximately 65 acres and is currently active. The complex included two storage buildings with vaults, a maintenance building, three other assembly/maintenance buildings, several storage igloos, two waste burial pit areas, five wastewater underground storage tanks (USTs), and 16 heating fuel USTs (Figure 3-18). The wastewater USTs were used to store water from the wash-down and cleaning of nuclear weapons that drained through the floor drains into the USTs.

Radioactive wastes were generated at EAFB between 1952 and 1962. The five wastewater USTs and 16 heating fuel USTs were removed in 1993 as part of a Base tank removal program. Although historical records indicate that there were two waste burial pits, the exact locations are not known. No available information has indicated that any ordnance or explosive radioactive wastes were disposed of at OU-7.

OU-7 included the Low-level Radioactive Waste Burial site located in the Weapons Storage Area (WSA) at the northern end of the Base. The WSA covers approximately 65 acres and is currently active. The site contained five underground tanks, which were designed to hold equipment wash-down water. The record search for the OU-7 investigation found no evidence that these tanks were ever used for the purpose of holding wash-down water containing radioactive materials. The tanks were emptied of water in 1993. In order to sample the soils surrounding the tanks, the tanks were removed and disposed.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-7. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

Scattered detections of VOCs were reported in surface soil samples at OU-7; concentrations were below 10^{-6} risk based concentrations for Human Health Risks. Radionuclides were determined to be present within the normal background range due to natural variations in soil types and geological characteristics. The residual VOCs at the OU were attributed to the use of these chemicals in the maintenance of weapon system components and equipment at this OU.

Some surface soil samples had concentrations of gross alpha and gross beta radioactivity exceeding the soil background range. However, the risks associated with ingestion and inhalation of, and dermal contact with, these contaminants by potential future residents and construction workers are very small and

within the acceptable range (I x 10^{-4} to 1 x 10^{-6} or less). Risks associated with construction worker exposure to gross alpha and gross beta and sev eral inorganic analyte (especially manganese) contaminants in UST pit soils are also minimal and within the acceptable range. Although VOCs, inorganics, and radionuclides were detected in sediment, the risks to potential future residents and construction workers from ingestion, inhalation, and/or dermal contact are within the acceptable range. There are no unacceptable risks to potential future residents and construction workers from ingestion and inhalation of, or dermal contact with, contaminants in surface water or ground water. Based on the minimal risks associated with contaminants in soils and ground water at the site, limited institutional controls for these media are warranted.

Results of the Tier I and II ecological risk assessment indicated that OU-7 does not exhibit significant ecological value due to its highly disturbed environment (OU-7 primarily consists of buildings, roads, and paved areas). There are small areas of potential grassland and wetland habitats at the OU. A variety of animal species may live, forage, or nest in OU-7 habitats. These species include various types of invertebrates, amphibians, birds, and mammals. terrestrial vegetation and soil faunal communities do not reveal characteristics that indicate chemical-related impacts.

3.8.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU.

3.9 OPERABLE UNIT 8 EXPLOSIVE ORDNANCE DISPOSAL AREA

3.9.1 Physical Setting

Operable Unit 8 (OU-8) is the current designation for the area surrounding and including the explosive ordnance disposal (EOD) Area. OU-8 was divided into two distinct areas of investigation. Area 1 is the actual EOD Area itself. Area 2 consists of the Debris Burial Area where waste from the EOD Area was buried. Sediments in drainages within and adjacent to the EOD Area are also included in OU-8. OU-8 is located in the extreme northeast corner of EAFB. Figure 3-2 shows the location of OU-8 at EAFB.

The EOD Area was approximately 600 ft by 1,350 ft and located in sloped rugged terrain in the northeastern corner of EAFB. Service roads parallel the two north-south trending ridges located along the eastern and western edges of this site. The area within the confines of these service roads is where explosive ordnance demolition was formerly conducted. Along with ordnance disposal activities, it is reported that an herbicide spill occurred in May 1982. Terrain in this area slopes predominantly toward the north. An unnamed ephemeral drainageway exists along the east and west edges and in the central portion of this area. This drainageway conducts surface flow off the site in a northerly direction.

The Debris Burial Area was approximately 300 ft by 150 ft and located on a ridge south of the EOD Area, in a less rugged area. Spent metal casings (small arms) were visible at the surface in this area. The terrain surrounding the ordnance burial area slopes gently toward the east.

The wetlands on OU-8 consist of ditch wetlands along portions of the two drainages, and three small impoundments created by the construction of the earth berms. The wetlands along the westernmost drainage begin north of the first berm; a narrow ditch wetland, approximately two feet wide, widens into a cattail slough created by the construction of the second earth berm. There was no water present in the ditch or the cattail slough at the time of the site visit, but the soil was saturated to the surface. The vegetation in the ditch was visibly different from the surrounding vegetation and was dominated by

hydrophytic species such as saltgrass (*Distichlis spicata*), foxtail barley, and curly dock (*Rumex crispus*). Vegetation in the slough was also dominated by hydrophytic species such as cattail (*Typha* sp.), saltgrass, foxtail barley and curly dock. Farther north, just south of the third berm, was a second slough.

3.9.2 Land and Resource Use

The habitat on OU-8 is dominated by mixed grass prairie. OU-8 is not developed; there are no buildings, parking areas, or even paved roads within the OU. Base activities, such as the detonation of active explosives, and the burial of debris created by explosives detonation, had visibly altered only a small portion of the OU-8 habitat. The most disturbed area on OU-8 is the EOD Area, which collectively refers to a burn pit area, burn furnace area, and a detonation area. The majority of the EOD Area is characterized by native black surface soil and very little vegetation.

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant species or fauna species classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

This OU has had the selected remedy completed, access is restricted to Base personnel and contractors responsible of the operation of the remedial systems. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

3.9.3 History of Contamination

The three processes were used to destroy munitions at EAFB: 1) open detonation; 2) open burning; or 3) detonation within a burn furnace. In open detonation an explosive charge is used as a donor charge to detonate a particularly explosive ordnance item at ground surface or in a shallow pit. In open burning, munitions are placed on top of a combustible material (such as wood) within a 4 ft. deep burn pit. Approximately 20 to 40 gallons of diesel fuel was poured on the munitions and combustible material in order to promote combustion. A burn furnace was considered the safer and more expeditious method of burning such items as small arms ammunition, delay elements, or primer detonators. The burn furnace consists of a diesel-fired furnace mounted on a concrete structure. Munitions were fed into the furnace through a feed chute. A smokestack and vent allow smoke and vapors to leave the furnace. If munitions were treated in the burn furnace, personnel would start a diesel fuel fire in the combustion chamber of the furnace. When operating temperature was reached, personnel slowly fed munitions into the feed chute. All burn furnace, burn pit, and detonation site residue has been transferred to the debris burial area just south of the explosive ordnance disposal area. Off-spec munitions are currently shipped off-Base as hazardous waste.

Product characteristics from the treatment processes (i.e. open burning, and open detonation) are also an environmental concern. Literature research indicated that the bulk of open burning and open detonation treatment residuals are evolved in gaseous or airborne particulate form. The gaseous components include CO, NO_x,N_2, SO_2, and $C0_2$. Particulates may include MgO, H2O, and HCL. In addition, trace quantities of primer compounds could result in the evolution of PbO. Solid residuals remaining after treatment are primarily metal casings, soot and a residual ash.

Approximately 100 gallons of prometon (Pramitol 25E) was reportedly released at the EOD area in May 1982. In June 1982, approximately 200 yd^3 of prometon- impacted soil was excavated from this site and transported to Landfill No. 3 (OU-4). Earthen dams were constructed out of native soil in 1983 in order to prevent off-Base movement of residual prometon. Approximately one year later, Base personnel

visually observes what they considered to be prometon leaching from OU-8 into ephemeral, surface-water drainageways (USAF, 1989). Sampling was not performed to verify the existence of pramitol leachate. During a site inspection in May 1992 it was observed that the earthen dams had been breached and were no longer impounding surface water flow. These dams were rebuilt as part of the remedial actions taken at OU-8.

OU-8 consisted of two distinct areas of investigation, the Explosive Ordnance Disposal (EOD) Area and the Debris Burial Area. The EOD site study area included a Pramitol spill area. burning pit area, burn furnace area, and a detonation site.

Volatile organic chemicals and SVOCs were detected in ground water during the remedial investigation (RI). The reported concentrations of these contaminants were less than or equal to 2 ug/l. No MCLs or EPA risk-based concentrations exist for the reported contaminants. Antimony and selenium were reported above the MCL in one or more ground water samples (Figure 3-19). Toluene was the only VOC detected in soil samples collected in the EOD area during the RI. PAHs and phthalates were also detected in the soil. PAHs typically result from incomplete combustion of organic materials. Dioxins in the soil correlated with combustion activities in the EOD area. Dioxin concentrations were low, well below action levels of 1,000 picograms/KG (**p**g/KG) for residential soils (Figure 3-20). The risk assessment for OU-8 indicated that there are no unacceptable non-carcinogenic or carcinogenic risks at the OU under current land use conditions, resulting from activities conducted at OU-8.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-8. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The risk assessment for OU-8 indicated that there are no unacceptable non-carcinogenic or carcinogenic risks at the OU under current land use conditions, resulting from activities conducted at OU-8. There were no carcinogenic risks identified in the OU-8 risk assessment as having a risk greater than 1×10^{-4}, resulting from activities conducted at OU-8. Dioxins in surface soil were the only chemicals identified in the RI present at concentrations greater than 10^{-6}. Risk associated with the dioxins in the surface soil is in the 10^{-5} range. Non-carcinogenic and carcinogenic risks were also identified for the OU from naturally-occurring inorganic chemicals in the soil and ground water; however, risks from naturally-occurring chemicals are not considered for remediation.

Chemicals detected in the ground water that contributed to excess risk are considered to be naturally occurring. therefore, remedial action is not warranted for the ground water at this time. The ground water at OU-8 was included as part of the Base-wide ground water evaluation for OU-11.

An ecological risk evaluation of OU-8 was based on a combination of data and literature reviews, field and laboratory analyses, analyte evaluation and screening, and preliminary risk screening. Due to the low levels of contaminant concentrations, the contaminants do not pose an unacceptable risk to these species. In addition, the limited contact these species would have with the OU-8 area ensures unacceptable risk to a single individual will not occur.

3.9.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU.

3.10 OPERABLE UNIT 9

3.10.1 Physical Setting

Surface topography is relatively flat in the western portion of the study area, sloping gently to the east at a gradient of approximately one percent. In the vicinity of the unnamed ephemeral stream, which is present along the east boundary of OU-9, topography is much steeper, sloping 5-20 degrees inward towards the stream on either side. Storm water flow in the OU-9 study area flows along unlined drainage ditches and underground storm sewer lines, eastward to the ephemeral stream and then south to Gateway Lake. The stream and Gateway Lake are part of a drainage system that collects storm water runoff from the center of the Base and directs it southward through a series of retention lakes (Bandit Lake, Heritage Lake, Gateway Lake) and interconnecting ephemeral streams (Figure 3-2).

3.10.2 Land and Resource Use

OU-9 is located in the south-central portion of EAFB in one of the older and more developed sections of the Base. Buildings and surface streets along the western part of the study area and asphalt lots and undeveloped grassy areas along the eastern and northeastern portion of the site generally characterize the area. Vegetation in the developed parts of the site is primarily limited to grassy areas alongside roads and buildings. The operable unit has traditionally been associated with the Old Auto Hobby Shop, located in the center of the study area on the southeast corner of Ryan Street and George Drive. The Auto Hobby Shop was razed in 1985. Another razed building in the area was the former location of a jet engine test stand located approximately 150 ft northwest of the Auto Hobby Shop. Buildings and surface structures surrounding the Auto Hobby Shop include Building 601 (jet engine repair) to the west, Building 605 (former hangar) to the southwest, Building 805 (warehouse storage) to the south, the present jet engine test facility to the east, and a one million-gallon water storage tank to the north.

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or fauna species classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

The U.S. Fish and Wildlife Service National Wetland Inventory Map (NWI) that includes Ellsworth Air Force Base, classifies the wetland community type present on OU-9 as Palustrine Emergent Seasonally Flooded (PEMC). Gateway Lake and a portion of the drainage just south of OU-9 are classified as Palustrine Aquatic Bed Semipermanently Flooded (PABF). Aquatic Bed wetlands are dominated by plants growing primarily on or below the surface of the water in most years. Two wetland areas are located on OU-9. The first is a drainage that enters the OU via a culvert under George Drive in the northeast portion of the investigative area (Figure 3-22). The drainage flows to the southeast through the eastern portion of the OU and eventually passes through a culvert under Ellsworth Drive, to exit OU-9. The second wetland present on OU-9 is a small kidney-shaped depression wetland located south

of where the drainage passes under Ellsworth Drive. Two wetlands located off OU-9, a drainageway just south of the OU investigative area, and a fringe wetland around Gateway Lake are also characterized with OU-9 because they are adjacent to the OU and receive runoff from it.

This OU is currently undergoing remediation under the OU-11 remedial action, and remains a functional portion of the Base. Access is available to Base personnel working at the various shops or buildings in the OU, and to Base personnel and contractors responsible of the operation of the remedial systems. Limited undisturbed grass areas on the OU area available to local wildlife for foraging, loafing and nesting. No specific use changes have been directed for this area as a result of the selected remedial actions.

3.10.3 History of Contamination

A number of different contaminant sources are present within and upgradient of the OU-9 study area which have the potential to impact environmental media at the operable unit. OU-9 consists of roughly equal portions of industrialized and undeveloped areas. Gateway Lake is also included as part of OU-9 and is located in the extreme southeast corner of the OU.

The types of potential contaminant source areas at OU-9 include: Building Operations, underground storage tanks (USTs), the former Quartermaster Gasoline Dispensing Area, the former fuel transfer line, industrial waste lines, jet engine test facilities, and upgradient source areas. There is no known documentation of major spills or releases at OU-9. Small volumes of fuels, oils, and solvents may have been released to the environment over time through incidental spills, leaks, and/or poor waste handling and disposal practices.

OU-9 consisted of the Old Auto Hobby Shop and the surrounding area and was approximately 90 acres in size. There was no documentation of a major spill or release at OU-9. However, small volumes of fuels, oils, and solvents may have been released to the environment over time. Low concentrations of VOCs, primarily BTEX, were found in soils (Figure 3-21). BTEX and chlorinated VOCs were detected in ground water (Figure 3-22). Because an upgradient source was suspected, ground water cleanup was addressed in OU- I 1 (the Basewide ground water Operable Unit).

A quantitative risk assessment was performed for the ground water. surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-9. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The risk assessment for OU-9 indicated that the risk for the future industrial land-use scenario, which is

similar to the current land-use, is within the acceptable risk range. For non-carcinogenic risk, the HI was 0.4, which is acceptable. For carcinogenic risk, the calculated risk value was 5×10^{-8}, which indicates

that there is no unacceptable current or future risk due to carcinogenic compounds. Using reasonable maximum exposure (RME) values, the risk for the residential land use scenario is within the acceptable risk

range. The risk for this scenario using average exposure values is also well within the acceptable risk range. The future industrial land-use and residential land-use risks do not warrant remediation, particularly given the most likely future land use will be industrial, and the soils are being remediated under State of South Dakota petroleum release regulations.

Potential risks posed by exposure to shallow ground water and ingestion of fish in Gateway Lake are being addressed as part of OU-11 and are not being addressed as part of OU-9. Because of these conclusions, remediation is not warranted for surface water, sediment, and soil at OU-9.

The ecological risk evaluation of OU-9 was based on a combination of data and literature reviews, field and laboratory analyses, analyte evaluation and screening, and preliminary risk screening. Results of the evaluation indicate that most of OU-9, other than Gateway Lake, does not present significant ecological value due to its highly disturbed environment (OU-9 consists primarily of buildings, roads, and paved areas). There is a small area of grassland and wetland habitat (including Gateway Lake) near the eastern boundary of OU-9. A variety of species was identified that could use OU-9 habitats, from snails and frogs inhabiting the wetland areas to birds and mammals. These species, along with terrestrial vegetation and soil faunal communities, do not reveal characteristics that indicate chemical-related impacts.

3.10.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU

3.11 OPERABLE UNIT 10 NORTH HANGER COMPLEX

3.11.1 Physical Setting

The land surface is relatively flat at the North Hangar Complex and slopes gently toward the southeast at a gradient of approximately 1 percent. The gradient in the surrounding area slopes to the south. The majority of OU-10 is paved, although grassy areas are present southwest and northeast of the site and in between the hangar rows.

No surface water bodies are present at OU-10, Figure 3-2. Storm water runoff within the hangar area is collected in underground storm-water drains. Storm-water lines at Rows 60 and 70 drain to the south beneath the runway, eventually emptying into an unlined drainageway that runs through the center of OU-12. this drainageway ultimately drains to an oil/water separator at Pond 001 adjacent to OU-1. Storm-water lines at Rows 80 and 90 drain to the west, beneath the runway and ultimately to an oil/water separation pond adjacent to the west property boundary.

3.11.2 Land and Resource Use

There are no permanent surface waters or wetlands on OU-10. There is virtually no natural habitat on the OU to support breeding, foraging, or sheltering of wildlife. The vegetation on OU-10 was not compared statistically to a reference area, but based on simple observation, the small grass median strips on OU-10 are entirely different from any reference area evaluated because they are mowed and managed.

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant species nor fauna species classified as rare, threatened. or endangered in South Dakota were observed on EAFB.

This OU is currently undergoing remediation. This Area is an active portion of the Base. However, access is restricted to Base personnel responsible for day-to-day operations at the Docks located in this area ands to Base personnel and contractors responsible of the operation of the remedial systems. This OU has few undisturbed grass areas on the OU that are usable by local wildlife for foraging, loafing and nesting.

3.11.3 History of Contamination

The North Hangar Complex was constructed in the 1950s and is composed of five rows of aircraft repair and maintenance hangars. Most of OU-10 is paved with concrete with some grassy areas between the hanger rows. No surface water is present at OU-10. The area contains a system of underground jet-fuel hydrant lines that deliver fuel to docking aircraft. The primary source of contamination at OU-10 is the fuel distribution system. Additional contaminant source areas include the aircraft maintenance areas and underground industrial waste lines. It was reported that waste products used for aircraft maintenance may have been washed down floor drains in the maintenance buildings. The remedial investigation focused on determining if these waste products were then discharged into the soil beneath the maintenance area and to determine if contaminants had leaked from the underground industrial waste lines.

OU-10 contains a system of underground jet-fuel hydrant lines that deliver fuel to docking aircraft and underground industrial waste lines associated with aircraft maintenance. Organics reported in soil samples included VOCs, SVOCs and jet fuel (Figure 3-23). The predominant VOCs were BTEX compounds (Figure 3-24). Ground water contamination associated with OU-10 was addressed within OU-11 (the Basewide ground water Operable Unit) for remediation.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-10. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The risk assessment for OU-10 indicated that the risk for the future industrial land-use, which is similar to its current use, is within the acceptable risk range. For non-carcinogenic risk, the HI was 0.006, which is acceptable. For carcinogenic risk, the calculated risk value was $2 \text{ X } 10^{-6}$, which indicates the risk is within the acceptable risk range. Potential risks posed by exposure to shallow ground water are being addressed as part of OU-11 and are not being addressed as part of OU-10. Because of these conclusions, remediation is not warranted under CERCLA for soil at OU-10.

An ecological risk evaluation of OU-10 was based on a combination of data and literature reviews, field and laboratory analyses, analyte evaluation and screening, and preliminary risk screening. Various types of invertebrates, amphibians, birds, and mammals may live, forage, or nest in OU-10 habitats. These species, along with terrestrial vegetation and soil faunal communities, do not reveal characteristics that indicate chemical-related impacts. This finding is consistent with the relatively low levels of contaminants in the soil.

Because of the altered natural environment at OU-10, rare, threatened, or endangered species are unlikely to utilize the area for more than brief; periodic habitat. Due to the low levels of contaminant concentrations, the contaminants do not pose an unacceptable risk to these species. In addition, the limited contact these species would have with the OU-10 area ensures unacceptable risk to a single individual will not occur.

Findings of the RI indicate that the contaminants at OU-10 are not altering the ecology to noticeable levels. A Base-wide ecological risk assessment will be conducted as part of OU-11, and OU-10 will be included in this Base-wide evaluation (ARSD Article 74:03).

3.11.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU.

3.12 OPERABLE UNIT 11 BASEWIDE GROUND WATER

3.12.1 Physical Setting

OU 11 is the Basewide Ground Water Operable Unit. The physical characteristics of this OU are consistent with those described for the Base as a whole in the introduction to Section 3.1 above, and as described in specific OU sections. Investigations completed at OU-11 were designed to fill in data gaps at specific locations across the Base that had been included in specific OU investigations. The OU-11 areas of investigation are shown on Figure 3-25, and are defined as:

- A Basewide ground water study.
- A Basewide ecological evaluation.
- The area surrounding well MW93BG04 (This area includes AOC-24).
- The area surrounding well MW93BG05 (This included AOC-24).
- Upgradient of OU-6, near MW930602.
- The South Docks Area.
- The northern edge of OU-12.

- Additional investigations at OU-7.
- The Pond 003 Area.

3.12.2 Land and Resource Use

Land uses in this OU range from open grassed areas to industrial areas covered with roads buildings and pavement. Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant or animal species classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

This OU is currently undergoing remediation and is closed to access, except for Base personnel and contractors responsible of the operation of the remedial systems. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

3.12.3 History of Contamination

Based on the risk assessment and an evaluation of the data collected as part of the Basewide Ground Water Study and the studied of the additional areas listed above, it was determined during the RI process that three areas warranted remediation as follows: the area surrounding well BG04, the area surrounding well BG05, and the South Docks Area. In addition, long-term monitoring was recommended for ground water at OU-8. The other areas investigated (upgradient OU-6, northern edge of OU-12, OU-7 [additional investigation], and the Pond 003 area) did not warrant remediation and were not included or discussed in the OU-1 1 ROD.

To facilitate project planning, OU-11 was divided into two parts, Area 1 and Area 2. Area 1 is the South Docks Study Area. This includes the South Docks and areas of ground water contamination in OU-9 that were deferred to OU-11. Groundwater contamination at OU-10 was also deferred to OU-011 for remediation; however, ground water contamination at OU-10 is the result of petroleum product releases and was addressed through the State of South Dakota Petroleum Release Program. Contaminated ground water in Area 1 lies entirely on-Base. Remedial alternatives developed for this area are referred to collectively as the "South Docks" alternatives since the South Docks is the primary area of contamination in Area 1. Area 2 is the area around BG04 and BG05, which includes areas where ground water contamination was found to leave the Base along the eastern boundary.

Area 1

The South Docks) is located in the central part of the Base between OU-9, OU-10, and the flightline. Major buildings in the area include the Pride Hanger and hangers in Rows 20, 30, 40, and 50, Figure 3-2.

Historical aerial photographs indicate that the Pride Hangar and the hangars in the South Docks Area have been in place since the late 1940s to early 1950s. Historically, the hangers have been used for the docking and maintenance of aircraft. The Pride Hanger was most recently used for storage, maintenance of missile-support equipment, for offices, and meeting rooms. In 1992, several underground storage tanks (USTs) were removed from the Pride Hanger. Hangers in the South Docks are now used for storage and maintenance of various support equipment, including aircraft refueling vehicles, fire-fighting vehicles, grounds-keeping equipment, and periodic parking of aircraft.

Other potential sources in the area include industrial waste lines, equipment wash racks, and historical chemical handling disposal practices. However, no specific incidents of hazardous material spills have been documented.

Area 2

The BG04 Study Area is located in an open grass area at the northeast edge of EAFB. approximately 1,500 ft south of the explosive ordnance disposal (EOD) debris burial area perimeter (OU-8). There are no known sources of contaminants in the immediate vicinity of BG04. A firing range is located approximately 1,200 ft to the northwest and a housing tract is located approximately 800 ft to the east of monitoring well MW93BG04. Area 2 includes the areas where ground water contamination has moved off-Base along the eastern boundary. Off-site contamination associated with these areas has also been referred to as Area Of Concern 24 (AOC-24). The contaminant of concern associated with Area 2 is TCE and its associated break down products. The contaminant plume has been defined east of the Base and currently extends approximately 5 miles to the east-southeast of the Base boundary. Twenty-five private water supply wells in the plume area have shown TCE levels in excess of the 5 ug/L MCL. The Base has installed a water line to 33 properties within the plume area to provide an alternate water supply until the TCE plume is remediated.

BG05 Study Area is located in a housing area in the east-central portion of EAFB, approximately 300 ft east of LeMay Boulevard and continues off-Base to the east. There are no known sources in the immediate vicinity of well BG05.

Ground Water at OU-8

Ground water at OU-8 was evaluated as part of the OU-1 1 remedial investigations. Detailed descriptions of the OU-8 area are described earlier in this document. It was determined that remediation of ground water at OU-8 was not warranted, therefore a detailed analysis of alternatives was not completed for ground water media at this OU. However, to comply with State landfill closure requirements, compliance monitoring was implemented to verify that chemical concentrations in the ground water do not pose unacceptable risk.

Contaminated ground water in Area 1 is located entirely on-Base, Figure 3-26 to 3-30.

Volatile organic compounds, SVOCs, and petroleum hydrocarbons were detected in ground water samples from the South Docks Area. Trichloroethene (TCE) was the most frequently reported compound in the ground water samples along with its breakdown products.

The ground water at OU-11 also was impacted by petroleum releases associated with refueling of airplanes at the flightline refueling area (FRA). No commingling of hazardous substances occurred at this site, therefore; remediation activities associated with the FRA are being addressed under the SDDENR petroleum release program.

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-12. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk

range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

At Area 1, the total carcinogenic risk to potential future residents from ingestion, inhalation, and dermal contact with contaminated ground water was estimated at 1.77×10^{-4}. This risk level exceeds the acceptable risk range of 1×10^{-4} to $l \times 10^{-6}$. At Area 2, the total carcinogenic risk to potential future residents from ingestion, inhalation, and dermal contact with contaminated ground water was estimated at 2.27×10^{-5}. This risk level is within the acceptable risk range. However, the ground water in Area 2 contains contaminants at concentrations greater than the MCL and contaminants have moved beyond the Base boundary. Remediation of ground water in Areas I and 2 was considered warranted because of the unacceptable risk to human health for exposure to contaminated ground water and to prevent further offsite movement of ground water containing contaminants at concentrations greater that the State of South Dakota Ground Water Quality Standards or Federal MCLs.

An ecological risk assessment was not conducted for OU-11 specifically since this was a ground water OU. However a Tier III ecological assessment was conducted as a Basewide evaluation using data from the Tier I and II evaluation completed at other OUs.

The result of this Basewide ecological assessment indicated that there was little to limited risk to ecological communities evaluated at EAFB from the site-specific exposures at individual OUs. No remedial actions were recommended as a result of the estimated ecological risks for an individual OU or for the Base as a whole.

3.12.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU.

3.13 OPERABLE UNIT 12 HARDFILL 1

3.13.1 Physical Setting

Surface topography at OU-12 generally slopes inward toward an ephemeral stream that flows in a southerly direction from the Primary Instrument Runway to the northern boundary of the alert apron. The drainageway through OU-12 is unlined. Hardfill areas on the east bank of the stream encroach into the drainageway and also serve as rip-rap in some places. The drainageway has undergone extensive channelization in order to divert water from the alert apron. The primary drainage is part of a stormwater drainage system that originates in the north part of OU-12. The source of water is stormwater runoff from the runways and surrounding areas, which collects in a french drain north of OU-12 and drains into OU-12 via a culvert. The drainage runs through the center of OU-12 and is ponded toward the south end. The drainage is channelized around the alert apron, and continues south through OU-1 and OU-2 before exiting the Base. It is less than ten feet wide along much of its length and contained about six to eighteen inches of slowly flowing water at the time of the survey. The pond is approximately 80 ft wide at its widest point and over 700 ft long. There appeared to be at least a few feet of water in the pond, but

no water flow was evident. A small, tributary drainage originates to the west of the primary drainage and joins with it north of the pond. This smaller drainage is fed by runoff from the west. The soil was only saturated along the upper part of the tributary drainage but up to a foot

of water was present near the junction. At the south end of OU-12, the ephemeral stream is more characteristic of a pond, which may contain water year round. There is minimal observable water flow within the ponded portion of the drainageway.

3.13.2 Land and Resource Use

Operable Unit 12 contains a variety of habitat features, some of which have been heavily influenced by human activities such as landfill operations and aircraft usage. In spite of this disturbance, some habitat still exists that could attract animal species that would be potential contaminant receptors.

The most disturbed areas on the OU are the hardfill areas, used to dispose of construction debris and concrete rubble. The largest hardfill area is located just west of the pond (widened drainageway) in the south part of OU-12. Another smaller hardfill area is located just to the east of the pond, and a third hardfill area is found farther north along the primary drainage. The hardfill areas are sparsely vegetated by weedy species such as annual sunflower (*Helianthus annuus*), summer cypress (*Kochia scoparia*), and bindweed. The only developed area on OU-12 consists of two small buildings and a circular gravel drive located in the southwest corner of the OU. A few dirt and grass field access roads are also located in the OU. Operable Unit 12 is bordered on three sides by a formerly used runway, the current runway, and the alert apron. Although not on the OU, these features may affect the accessibility and attractiveness of wildlife habitat on OU-12.

Field surveys were conducted at EAFB in 1993 for threatened and endangered species. No sensitive plant species nor fauna species classified as rare, threatened, or endangered in South Dakota were observed on EAFB.

This OU is currently undergoing remediation and is closed to access, except for Base personnel and contractors responsible of the operation of the remedial systems. Undisturbed grass areas on the OU may be used by local wildlife for foraging, loafing and nesting. No specific future use has been determined for this OU.

3.13.3 History of Contamination

Historical aerial photographs indicate the area has been used for dumping of construction debris such as wood, metal, concrete, and asphalt since the 1940s. Construction debris was visible over portions of OU-12, although much of the former disposal area is covered by vegetation. Disposal of hazardous materials has not been documented at OU-12; however, the area was designated as an operable unit based on historical disposal practices at the Base.

OU-12 was located in the southern half of EAFB, immediately north of the Alert Apron and southwest of the runway. OU-12 was designated as Hardfill No. 1, which was approximately 14 acres in size. This landfill received building and road demolition rubble from maintenance and repair activities on the Base. Historical records indicated that the landfill was used for disposal of this demolition rubble only, and did not receive hazardous wastes. The investigation showed the presence of VOCs. SVOCs, jet fuel and pesticides, but through site characterization it was found that these ontaminants were related to flightline runoff rather than landfill disposal practices (Figure 3-31). Levels of contaminants observed in the

ground water at the site were below Maximum Contaminant Levels. A single upgradient well reported TCE in a ground water sample at a concentration of 7 ug/L (Figure 3-32).

A quantitative risk assessment was performed for the ground water, surface water, soil, sediment, and air. The risk assessment evaluated potential effects on human health posed by exposure to contaminants from OU-12. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer

over a lifetime as a result of exposure to a potential cancer-causing chemical. The acceptable risk range expressed as a probability is one cancer incidence in ten thousand people to one cancer incident in a million people. This level of risk is also denoted by 1×10^{-4} to 1×10^{-6}. Risks within the acceptable risk range may or may not warrant remedial action depending upon site-specific circumstances. Risks below this range cannot be differentiated from the background occurrence of cancer in human populations. Risks calculated in a risk assessment are excess (i.e., over background) cancer risks due to exposure from contaminants.

Non-carcinogenic health risks are evaluated using a hazard index (HI). If the hazard index is less than or equal to one, the contaminant concentration is considered an acceptable level and generally assumes that the human population may be exposed to it during a 30-year period without adverse health effects.

The risk assessment for OU-12 indicated that the total carcinogenic site risk is within the acceptable risk range for the residential (future) scenario and is less than 1×10^{-6} for the industrial (current) scenario.

A surface water drainage channel runs through and also along the southern boundary of OU-12. This channel contains areas of wetlands. Remedial construction activities at the OU resulted in some reworking of soil and drainage channel relocation in the wetland areas. Replacement wetlands were constructed near other Base lakes located near the center of EAFB.

The risk assessment for OU-12 indicated that the total carcinogenic site risk is within the acceptable risk range for the residential (future) scenario and is less than 1×10^{-6} for industrial (current) scenario. The majority of the total carcinogenic site risk for the residential scenario is from exposure to surface soil contaminants from within the hardfill. The non-carcinogenic His are below the reasonable maximum exposures (RME) of 9×10^{-5} for current industrial land use and 1×10^{-1} for future residential land use. the average His for both current industrial land use and future residential land use were 3×10^{-6} and 5×10^{-2} respectively. However, due to the heterogeneity of the hardfill contents, great uncertainty is associated with the calculated risk values.

Arsenic and benzo(a)pyrene in the sediment of the drainage areas also contributed to the total site risk. Based on the risk assessment (risk calculated for sediment is 3×10^{-6}), and other factors such as maximum concentrations, distribution, detection frequency, etc., remediation is not warranted for sediment at OU-12.

The risk to human health from the ingestion and use of the shallow ground water is 2×10^{-6}. This is on the lower end of the acceptable risk range. Based on this calculated acceptable risk and low concentrations of contaminants detected in ground water samples, remediation is not warranted for ground water.

The calculated risk level for the surface water at OU-12 is 8×10^{-8} which is below the acceptable risk range. Remediation is not warranted for surface water as part of OU-12.

A variety of potential receptors were identified that may live, forage or nest in OU-12 habitats. These range from benthic invertebrates and amphibians in the drainage channels to birds and mammals. Terrestrial vegetation and fauna communities did not show patterns indicating elevated chemical exposure-related impacts. this finding was considered consistent with the relatively low levels and limited distribution of elevated chemical concentrations in soil, and the active and disturbed nature of the site observed during the RI. Tier III investigations were not completed at this site but the COCs were carried over to the Basewide Tier III assessment.

Remedial action is warranted for the hardfill based on the potential risk to human health from future releases of hazardous substances from the hardfill. Contaminants in the hardfill may leach downward to contaminate the underlying ground water. Off-Base residents may then ingest or come in contact with the contaminated ground water. Also, the surface of the hardfill may erode, thus exposing off-Base residents to contaminants in both surface water and air.

3.13.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU.

3.14 FLIGHTLINE REFUELING AREA

The Flightline Refueling Area consists of three adjacent sites (originally designated SS-08. ST-10, and ST-14) surrounding seven jet fuel pump houses. The study area is located between the operable apron and the primary instrument runway in the central part of the Base (Figure 3-33).

3.14.1 Physical Setting

Soils at the site are described as typically consisting of tan, hard silty clay from 3 to 12 ft below ground surface, underlain by loose to dense clayey sands and gravels to sandy gravels ranging in thickness from approximately 5 to 15 ft. These sediments are typical of the relict channel deposits, which are present over portions of EAFB. Unconsolidated sediments are underlain by hard, gray to black weathered shale, which is typically present at depths ranging from 18 to 24 ft below ground surface. At an abandoned soil boring drilled approximately 50 feet northwest of Pump House No. 5, sands and gravels were not observed and weathered shale bedrock was encountered 8 ft below ground surface, suggesting a localized pinching-out of unconsolidated channel deposits in this area. Overall, the shale bedrock surface appears to slope to the southeast.

Depth to ground water typically ranges from 13 to 20 ft below ground surface. Ground-water elevations in the wells indicate a gradient to the southeast, similar to the slope of surface topography. Ground water is present within the sand and gravel sediments approximately 2-5 ft above the weathered shale bedrock interface.

3.14.2 Land and Resource Use

This area consists of a grassed field with seven pump houses located west of the main runway at EAFB. The area has been graded flat and matches the gradient contours of the flightline. The only above grade structures are the pump houses and adjacent piping controls associated with each pump house. The pump houses dispense JP-4 for aircraft refueling from underground storage tanks adjacent to each pump house. Previous fuel release incidents which occurred at all of the pump houses between 1972 and 1984 were reported in the IRP Phase I Records Search (1985), and sampling was performed during the IRP Phase II

investigations (Stage 1 - 1987 and Stage 2 - 1989) which identified petroleum hydrocarbons in the soil and

ground-water samples.

3.14.3 History of Contamination

The most commonly reported VOC were benzene, ethylbenzene, and xylenes, with isolated occurrences of non-JP-4 related compounds (e.g. chloroform, methylene chloride, TCE, 1,1,1-trichloroethane, tetrachloroethylene, and 1,1,2,2-tetrachloroethane). (Note that because some samples contained elevated petroleum hydrocarbon concentrations, which required sample dilution for analysis, the chlorinated VOC detection limits for some samples were greater than regulatory MCL.)

TPH JP-4 (extractable and purgeable fractions) was reported in samples from 14 of the wells. The distribution of extractable TPH JP-4 in ground-water samples at the time of the Corrective Action Plan investigation is shown in Figure 3-34. A summary of reported petroleum hydrocarbon compounds in ground-water samples relative to the pump house locations is provided below:

- Pump House No. 1 - Benzene (12 ug/1), ethylbenzene (16 ug/l), xylenes (1.3 ug/1) and purgeable TPH JP-4 (280 ug/l) were reported in the sample from well MW87CP01. Ethylbenzene (140 ug/l) and purgeable TPH JP-4 (1,300 ug/l) were reported in the sample from MW93CP14.

- Pump House No. 2 - Benzene (27 ug/1), ethylebenzene (270 ug/1), xylenes (210 ug/1), and extractable and purgeable fractions of TPH JP-4 (9,400 and 5,700 ug/1, respectively) were reported in the sample from well MW87CP02. Ethylbenzene (300 ug/1), xylenes (830 ug/1), and extractable and purgeable fractions of TPH JP-4 (16,000 and 11,000 ug/l, respectively) were reported in the sample from well MW89CP12. Purgeable TPH JP-4 (180 ug/1) was reported in the sample from well MW93CP10.

- Pump House No. 3 - Benzene (26 ug/1), ethylbenzene (220 ug/1), xylenes (190 ug/1), and extractable and purgeable fractions of TPH JP-4 (5,300 and 2,600 ug/1, respectively) were reported in the sample from well MW87CP03. Benzene (620 ug/1), ethylbenzene (130 ug/l), xylenes (120 ug/l) and extractable and purgeable fractions of TPH JP-4 (30,000 and 12,000 ug/l, respectively) were reported in the sample from well h1W89CP09. A concentration of 110 ug/l purgeable TPH JP-4 was reported in the sample from well MW93CP18.

- Pump House No. 4 - Benzene (66 ug/1) and purgeable TPH JP-4 (180 ug/1) were detected in the sample from well MW87CP04. Ethylbenzene (6 ug/1), xylenes (14 ug/l), and extractable and purgeable fractions of TPH JP-4 (5,900 and 2,000 ug/l, respectively) were reported in the sample from well MW93CP20. Wells MW89CP10 and MW93CP07 were not sampled due to the presence of LNAPL.

- Pump House No. 5 - Benzene (190 ug/1), ethylbenzene (130 ug/l), xylenes (120 ug/1), and extractable and purgeable TPH JP-4 fractions (13,000 and 3,600 ug/l, respectively) were reported in the sample from well MW87CP05. Benzene (1,900 ug/l), ethylbenzene (140 ug/1), xylenes (500 ug/1), and extractable and purgeable fractions of TPH JP-4 (9,200 and 10,000 ug/1, respectively) were reported in the sample from well MW89CP11. Benzene (24 ug/1) and purgeable TPH JP-4 (540 ug/l) were reported in the sample from well MW93CP11.

- Pump House No. 6 - The purgeable fraction of tPH JP-4 was reported in the sample from well MW93CP06 at a concentration of 600 ug/l.

- Pump House No. 7 - The purgeable fraction of TPH JP-4 was reported in the sample from well MW93CP15 at a concentration of 520 ug/l.

3.14.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this area.

3.15 OFF-BASE JP-4 SOUTH OF OPERABLE UNIT 2

3.15.1 Physical Setting

Surface topography generally slopes in a southerly direction from the southern boundary of EAFB.

Surface water flows through the off-Base area in a small stream originating from Pond 001. Stream flow measurements were conducted on 21 July 1993, at OU-2 surface water sample locations on this stream. The stream flow measurements indicate that this unnamed stream had an average discharge of approximately 1.14 cfs. The OU-2 stream flow measurements were measured during peak flow of a rain event. This stream ultimately discharges into Box Elder Creek.

3.15.2 Land and Resource Use

The off-Base area is a grass covered pasture located adjacent to the south boundary of OU-2 landfill 1. This area consists of open grassland. The area had been used a pasture for livestock. The vegetation is primarily introduced grasses and weedy species. The grasses are primarily crested wheatgrass and smooth brome. Wetlands in the area consist of a retention pond at OU-1 and its drainageway, which flows off-Base along the western edge of this study area.

3.15.3 History of Contamination

JP-4 contamination caused by a leak in a fuel line was identified along the southern boundary of OU-2 in 1989. The fuel line was punctured during the Stage 2 IRP field investigations at OU-2. The 12-inch fuel line was shut off within 30 minutes and a trench was excavated to repair the line. Base records indicated fuel was recovered with buckets and rags, no record of the fuel volume leaked was reported, the Base fire chief estimated the leak at 25 gallons. This JP-4 contamination is being remediated under the SDDENR petroleum release program.

Total petroleum hydrocarbon, as jet fuel, was reported in soil samples at concentrations ranging from 170 to 2, 000,000 ug/kg. The results indicated that the highest concentrations were in samples collected from moist sand and gravel deposits, south of the landfill perimeter. Total BTEX in ground water samples were reported at concentrations ranging from < analytical detection limits to 9 ug/L. Ground water samples were not analyzed for Oil and Grease or TPH during the RI investigations. However, data collected during the IRP Phase II investigation Indicated that groundwater samples had reported concentrations of 1 mg/L to 49 mg/L of Oil and Grease. Current plume concentrations are shown on Figure 3-36

3.15.4 Initial Response

No CERCLA removal actions or other initial cleanup actions were completed at this OU. A site in the southwest corner of Landfill 1 identified during RI geophysical investigations was excavated in 1997. This location contained remnants of chemical weapons training materials. The identified material was excavated and moved off-Base for disposal at a licensed wasted disposal facility.

4.0 REMEDIAL ACTIONS

4.1 REMEDY SELECTION

This section describes the remedies selected at each of the 12 operable units. The remedies are summarized in Table 4-1.

4.1.1 Operable Unit 1

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force determined that source area soil treatment and ground water treatment was the appropriate remedial action. This alternative includes institutional controls in conjunction with physical modification of the OU to reduce potential risk. Major components of remedy specified in the record of decision (ROD) were:

- Continued operation of the installed as part of the IRA which consists of (1) eight SVE wells to remediate a portion of the source area soils and (2) four dual phase ground water wells and an existing collection trench to remove contaminated ground water near the source area..

- Installation and use of four additional SVE wells, seven dual phase ground water wells, nine ground water extraction wells, and a dual phase extraction trench.

- Soil gas and contaminated ground water would be treated at the IRA treatment plant. The water effluent will either be discharged to surface water, injected underground, or discharged to the Base wastewater treatment plant.

- Implementing institutional controls (deed and land use restrictions) to restrict the future use of the area while the remedy is being implemented.

- Providing for long-term ground water monitoring at the OU to identify development of future risks associated with the OU. Providing long-term maintenance of the remedial actions taken at the OU.

In addition to the installation of SVE and ground water extraction wells the IRA included the construction of a plant for the treatment of the soil gas and contaminated ground water. The treatment system includes 10 dual extraction wells built as a part of the 1995-1996 Remedial Action project. It also includes the ground water treatment systems in Building 6908 that pump contaminants to oil/water separators, air strippers/carbon absorption units and discharge to the building industrial wastewater line.

The objective of this alternative is to decrease soil contaminant concentrations within the burn-pit to the levels listed in Table 4-2 and to remediate the shallow aquifer to levels listed in Table 4-3.

The area targeted for SVE is the burn-pit area (Figure 4-1). Additional SVE wells were placed in the burn-pit area to remove soil contamination that was not addressed in the IRA.

TABLE 4-1

SUMMARY OF APPLIED REMEDIAL ALTERNATIVES FOR EAFB

Remedial Action	OU-1	OU-2	OU-3	OU-4	OU-5	OU-6	OU-7	OU-8	OU-9	OU-10	OU-11	OU-12
INSTALLED REMEDY												
No Action									X[5]	X[5]		
Soil Vapor Extraction	X											
Ground Water Extraction Wells	X	X		X			X[1]				X	
Ground Water Extraction Trench	X											
Monitored natural attenuation											X	
Alternative water supply											X	
Earthen Cover		X	X	X	X	X		X				X
Realignment of Storm-water channel		X				X						
Pre-Design stud for landfill as			X	X								
INSTITUTIONAL CONTROLS												
Deed Restrictions[2]	X	X	X	X	X	X	X	X			X	X
Continuing Order[3]	X		X	X	X	X	X	X			X	X
Wetland loss mitigation		X				X						
Records Search/removal action[4]							X					
Fencing	X	X	X	X	X	X		X			X	X
OPERATION/MAINTENANCE												
Long Term Operation/Maintenance Program	X	X	X	X	X	X	X	X	NA	NA	X	X
Long Term Monitoring Program	X	X	X	X	X	X	X	X	NA	NA	X	X

Notes:

1 Extraction of ground water containing low levels of TCE was done as a voluntary removal and not a ROD requirement.

2 Deed restrictions would be placed on any property transferred from Air Force ownership-this has not occurred at any of the above listed areas.

3 The continuing order is a Base Commander level directive specifying access and use restrictions on the OU areas.

4 This records search/removal action was related specifically to low-level radiological waste material disposal areas within the OU.

5 Ground water extraction and monitoring at this site was deferred to OU 11 the Basewide ground water OU.

Ground water wells and/or collection trenches were installed to remediate the contaminated shallow aquifer at OU-1 to the levels listed in Table 6. The number and placement of wells and/or trenches was evaluated during system design. The ground water wells and trenches collect and remove contaminated ground water at OU-1 (Figure 4-2). The aquifer is expected to be remediated in 10-15 years.

Extracted soil gas, condensate from the SVE wells, and ground water removed by wells and trenches contain both VOCs and petroleum hydrocarbons. These contaminants are treated at the treatment plant built for the IRA. Treatment of the soil gas and contaminated ground water consists of filtration, air stripping, activated-carbon adsorption, and thermal oxidation.

The water effluent from the treatment plant is discharged into a drainage, which flows into Pond 001. The effluent is monitored prior to discharge to determine the effectiveness of the treatment system. Effluent discharge standards and monitoring were determined during the design phase and are subject to State and EPA reviews and approvals. Off-gas from the thermal oxidizer was monitored to ensure compliance with Federal, State, and local requirements under the provisions of the Clean Air Act. The thermal oxidizer is no longer needed, due to the low level of volatile emissions, and has been removed from the treatment system.

Institutional controls were implemented to prevent human exposure to contaminated soil and ground water. These controls include: (1) issuing a continuing order (see Appendix D) to restrict on-site worker access to contaminated soil, and to restrict or control temporary construction activities unless proper protective equipment is worn; (2) filing a notice with the State to recommend denial of water appropriation permit applications to install ground water wells within the area of contamination and any area which may be effected by potential contaminants; (3) filing a notice to the deed detailing the restrictions of the continuing order and ground water well restrictions; and (4) a covenant to the deed in the event of property transfer.

Continuing Order requirements will be in effect as long as the property is owned by Ellsworth AFB, and the remedial action has not reached remediation goals. In the case of the sale or transfer of property within OU-1 by the United States to any other person or entity, the Air Force will place covenants in the deed which will restrict access and prohibit disturbance of contaminated soils or the remedial action without approval of the United States. These covenants will be in effect until removed upon agreement of the State of South Dakota, the U.S. Environmental Protection Agency, and the U.S. Air Force or their successors in interest. The Air Force will also include in the deed the covenants required by section 120(h)(3) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), which include (1) a warranty that the United States will conduct any remedial action found to be required by law after the date of the transfer; (2) a right of access on behalf of EPA and the Air Force or their successors in interest to the property to participate in any response or corrective action that might be required after the date of transfer. The right of access referenced in the preceding sentence shall include the State of South Dakota for purposes of conducting or participating in any response or corrective action that might be required after the date of transfer.

A maintenance program was established to ensure the long-term integrity of the removal and treatment system. The maintenance program includes development of standard operating procedures (SOPS) to provide for inspections, repairs, and leak response actions.

A long-term monitoring program was developed and implemented during remedial action and is subject to approval of both EPA and SDDENR. Contaminant concentrations from the treatment plant vapor stream

and treated ground water are monitored to evaluate the effectiveness of the system in removing VOCs from the contaminated media. Contaminant concentrations in the burn-pit area and in the ground water are also monitored. Continued analysis and monitoring of the ground water remedial action system performance is conducted to determine if the remediation system is reaching the established clean up goals, is approaching an asymptotic level due to physical limitations of the site, or the benefits of the remedial action no longer justify long-term operation of the system.

TABLE 4-2

OU-1 CLEAN-UP GOALS
Soils (ug/kg)

Analyte	Clean-up Goal	Model Estimates[(1)]	Basis
1,2-Dichloroethylene (1,2-DCE)	41	41.4	Ground water protection
Benzene	10[(2)]	2.5	Ground water protection
Teirachloroethylene (PCE)	10	10.5	Ground water protection
Trichloroethylene (TCE)	10[(2)]	3.3	Ground water protection
JP-4	500,000[(3)]	-	State Regulation
Toluene	15,000[(3)]	-	State Regulation
Ethylbenzene	10,000[(3)]	-	State Regulation
Xylene	300,000[(3)]	-	State Regulation
Naphthalene	25,000[(3)]	-	State Regulation

Notes:
(1) Based on SUMMERS Model (Summers. 1980)
(2) When the model estimates are less than standard detection limits, remediation clean-up goals will be based on standard detection limits.
(3) State of South Dakota Remediation Criteria for Petroleum Contaminated Soil, Tier 1 action levels at petroleum release sites, which would require a corrective action plan or Tier 2 analysis (ARSD Chapter 74:03:33).

TABLE 4-3

OU-1 CLEAN-UP GOALS
Ground Water (ug/L)

Analyte	Clean-up Goal	Basis
1,2-Dichloroethane (1,2-DCA)	5.0	MCL
1,1-Dichloroethylene (1,1-DCE)	7.0	MCL
1,2-Dichloroethylene (1,2-DCE)	70.0	MCL
1,1,1-Trichloroethane	5.0	MCL
Benzene	5.0	MCL
Tetrachloroethylene (PCE)	5.0	MCL
Trichloroethylene (TCE)	5.0	MCL
Vinyl Chloride	2.0	MCL
TPH	10,000	State Regulation
Ethylbenzene	700	State Regulation
Toluene	1,000	State Regulation
Xylene	10,000	State Regulation

4.1.2 Operable Unit 2

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force determined that the appropriate remedial action for Landfill No. 1 was the placement of an Earth Coyer and Institutional Controls. This alternative includes institutional controls, storm-water channel realignment and lining, in conjunction with physical modification of the OU to reduce potential risk. The selected remedial action for Landfill No. 6 was Institutional Controls. This alternative uses access restrictions, monitoring, and other controls to reduce potential risk.

For Landfill No. 1, major components of selected remedy are:

- Installing an earth cover over the area of attainment at Landfill No 1.
- Institutional controls to restrict future use of the operable unit.
- Realignment and lining of the storm-water channel.
- Providing for long-term monitoring to identify development of future risks associated with the operable unit. Providing long-term maintenance for the remedial actions taken at the operable unit.

The OU-2 system includes 11 dual phase extraction wells, some of which were installed as part of the 1994 containment pump and treat Interim Remedial Action, plus three soil vapor extraction points that were installed as part of the final Remedial Action in 1995 (Figure 4-3).

4.1.3 Operable Unit 3

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force determined that the appropriate remedial action was the placement of a Vegetative Soil Cover. This alternative includes institutional controls in conjunction with physical modification of the OU to reduce potential risk. Major components of remedy are:

- Placing a soil cover capable of sustaining perennial vegetation, over the landfill area.
- A pre-design study to examine the need for landfill gas control measures.
- Institutional controls for the landfill area.
- Long-term ground water monitoring, and long-term maintenance of soil cover.

The final Remedial Action OU-03 consisted of landfill covers and the installation of ground water monitoring wells. At OU-3, four existing monitoring wells are sampled and analyzed for VOCs, PAHs, metals, and indicator parameters (Figure 4-4).

4.1.4 Operable Unit 4

The selected alternative for the landfill. soil cover, includes the following major components:

- Institutional controls for the landfill area.
- Placing a soil cover capable of sustaining perennial vegetation over the landfill area.
- Landfill gas monitoring and passive collection system, as necessary.
- Long-term monitoring and maintenance.

The selected alternative for the ground water, pump and treat, includes the following major components:

- Continued operation of the ground water extraction wells installed as part of the interim remedial action (IRA), and treatment of contaminated ground water.
- Installation of recovery trenches and/or additional extraction wells to be added to the existing IRA ground water recovery system.
- Treatment of removed ground water at the treatment plant built for the IRA.
- Discharge of treated ground water to a surface water drainage, to the Base wastewater treatment plant, or by underground injection.

The OU-4 system includes ground water extraction wells that were installed as a part of a 1995 IRA project, plus the additional wells installed as part of the final RA in 1996. The total system consists of 26 ground water extraction wells. It also includes the ground water treatment system in Building 6908, which was built as a part of the 1995 IRA project and 12 monitoring wells (Figure 4-5).

4.1.5 Operable Unit 5

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force has determined that the selected alternative is Alternative 3, Vegetative Soil Covering. This alternative includes institutional controls in conjunction with physical modification of the OU to reduce potential risk. Five-year reviews of the remedy will be required because potential contaminants will remain at OU-5 following completion of remedial action.

The selected alternative, Covering, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the landfill area.
- Institutional controls for the landfill area.
- Long-term ground water monitoring; and, long-term maintenance of soil cover.

The final Remedial Action OU-5 consisted of landfill covers and the installation of ground water monitoring wells. A total of four monitoring wells are sampled and analyzed for VOCs, metals, and indicator parameters (Figure 4-6).

4.1.6 Operable Unit 6

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force determined that the appropriate remedy was the placement of a Vegetative Soil Covering. This alternative included institutional controls in conjunction with physical modification of the OU to reduce potential risk.

The selected alternative, Covering, included the following major components:

- Installation of fencing to control physical access to the landfill area. Posting the area to indicate the landfill is closed to further use.
- Implementation of institutional controls (deed and land use restrictions) to prevent future use of the area for residential use and/or limiting its use to industrial uses.
- Providing a minimum of one foot of sustainable earthen cover over the area of attainment (approximately seven acres).
- Grading and contouring the area to maintain stability and route surface water precipitation away from previously active fill areas and prevent ponding of the water.
- Extending an existing stormwater drain to the south and east of the landfill area to prevent the erosion of fill material and future potential contact with contaminated sediment.
- Providing and maintaining suitable vegetation to enhance evapotranspitration and reduce infiltration and soil erosion.
- Mitigating any wetlands affected by placement of the cap.

Providing for long-term ground water, surface-water, and sediment monitoring at her OU to identify development for future risks associated with the OU. Providing long-term maintenance of the remedial actions taken at the OU.

The final RA for OU-6 consisted of landfill cover construction and the sampling and analysis of four monitoring wells. The landfill cover construction was completed in 1996, and sampling of the monitoring wells began in July 1996. Two wells were installed in July 1998 to better monitor downgradient areas of the landfill (Figure 4-7).

4.1.7 Operable Unit 7

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and consultation with EPA and the State, the Air Force determined that appropriate remedy was a combination of institutional controls for soil and institutional controls for ground water with additional monitoring. This alternative includes institutional controls in conjunction with comprehensive ground water monitoring and monitored natural attenuation to evaluate and reduce potential future risk.

The following major components comprise the soil remedy:

- Institutional controls for future land use.
- An extensive records search w ill be performed that may provide additional information relating to the burial trenches. A removal action might be used to address waste within the trenches if the weight of evidence from this records search combined with previous information identifies and warrants this type of remedial activity.

The ground water remedy includes the following major components:

- Institutional controls for ground water use.
- Implementing a long-term ground water monitoring and maintenance program.

The OU-7 remedial action consisted of a voluntary action to pump and treat trichloroethylene-contaminated ground water from an existing monitoring well at the northeast corner of the Weapons Storage Area. The RA includes sampling and analysis of 4 monitoring wells for VOCs (Figure 4-8).

4.1.8 Operable Unit 8

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State. The Air Force determined that the appropriate remedy for the EOD Area was the construction of a vegetative soil cover and application of institutional controls. The selected remedy for the Debris Burial Area was also placement of a vegetative soil cover and application of institutional controls.

For the EOD Area, components of the selected remedy are:

- Constructing an earth cover over the EOD Area.
- Institutional controls for the EOD Area.
- Long-term sediment sampling.
- Long-term maintenance of earth cover.

For the Debris Burial Area, components of selected remedy are:

- Constructing an earth cover over the Debris Burial Area.
- Institutional controls for the Debris Burial Area; and, long-term maintenance of earth cover.

The OU-8 remedial action consisted of the placement of cover soils over two areas and the construction of one new monitoring well. In addition, drainage facilities in the area were re-constructed to from runoff retention basins to retain any contaminated soils that may be carried off the OU by runoff (Figure 4-9). A total of one monitoring wells will be sampled and analyzed for VOCs, explosives, and TPH-extractables

to perform long-term monitoring of ground water. Sediment will be sampled and analyzed at two locations for dioxins.

4.1.9 Operable Unit 9

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force determined that the appropriate remedy for ground water and the fish-ingestion pathway at OU-9 would be better addressed under OU-11, the Basewide ground water OU. Ground water contamination originates upgradient and extends beyond the boundaries of OU-9 and would be more efficiently addressed concurrently with other areas of the Base as part of OU-11.

The "No Action" alternative was selected as the appropriate remedy for the remaining media of concern: surface water, soil, and sediment. No action is warranted when a site poses no unacceptable current or future threat to people or the environment, when CERCLA does not provide cleanup authority, or when a previous cleanup activity eliminates the need for future cleanup. Unacceptable risk to human health or the environment from the contaminants related to OU-9 does not exist. Cleanup of petroleum-type chemicals will be addressed under State of South Dakota petroleum release regulations. Based on the above conclusions, no action was warranted for soil, surface water, and sediment cleanup at OU-9.

4.1.10 Operable Unit 10

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force determined that the appropriate remedy for ground water at OU-10 would be better addressed under OU-11, the Basewide ground water OU. Ground water contamination extends beyond the boundaries of OU-10 and would be more efficiently addressed concurrently with other areas of the Base as part of OU-11.

The "No Action" alternative was selected as the appropriate remedy for the remaining media of concern, soil. No action is warranted when a site poses no unacceptable current or future threat to people or the environment, when CERCLA does not provide cleanup authority, or when a previous cleanup activity eliminates the need for future cleanup. The low levels of contamination in the soil at OU-10 do not pose an unacceptable risk to human health or the environment. Cleanup of petroleum-type chemicals will be addressed under State of South Dakota petroleum release regulations. Based on the above conclusions, no action was warranted for soil cleanup at OU-10.

4.1.11 Operable Unit 11

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force determined that the appropriate remedy for ground water at OU-11 would be ground water extraction and treatment with containment. OU-11 remedial alternatives were developed for Area 1 and Area 2.

The selected alternative for Area 1 was ground water extraction and treatment with containment, included the following major components:

- Ground water removal and treatment in the South Docks Study area.

- On-Base containment of ground water containing contaminants at concentrations above Federal Maximum Contaminant Levels (MCLs) and State of South Dakota Ground water Quality Standards.

- Institutional controls and long-term monitoring.

The selected alternative for Area 2 was ground water extraction and treatment with containment, included the following major components:

- Ground water removal and treatment along the northeast Base boundary and at areas of high concentration on-Base.

- Monitored natural attenuation of low contaminant concentration areas, primarily of-Base.

- Alternative water supply to residents affected by contamination coming from the Base.

- Additional investigation to determine the eastern extent of off-Base ground water contamination.

- Institutional controls and long-term monitoring.

- Collectively, the selected remedies for Area 1 and Area 2 constitute the entire remedial action for OU-11 at EAFB.

Area 1 includes 17 vacuum dewatering well points, 14 ground water extraction wells and 4 dual extraction wells to serve the Pride Hangar, Building 102, 30 Row, 50 Row, and the south end of the South Docks. Area 1 is served by the stand-alone treatment facility at FRA-PH1. This project includes daily operation of the Area 1 systems and quarterly sampling and analysis of 6 monitoring wells for TCE (Figure 4-10). Area 2 consists of the BG-04/BG-04 West/BG-05 area at the northeast corner of the base, where a TCE plume has moved east off the base. The BG-04/BG-04 West/BG-05 area includes 11 ground water extraction wells, with carbon and air stripping treatment and re-injection of treated ground water through trenches (Figure 4-11). The project provides for the daily operation of the ground water extraction wells for containment at the base boundary in the BG-04/BG-05 areas. Project also includes quarterly sampling and analysis of 10 monitor wells for TCE. The OU-11 system is expected to operate daily for a period of twenty years.

4.1.12 Operable Unit 12

Based on the requirements of CERCLA, comparative analysis of the nine criteria, public comments, and in consultation with EPA and the State, the Air Force determined that the appropriate remedy for OU-12 was capping. This alternative includes institutional controls in conjunction with physical modification of the OU to reduce potential risk. Major components of the selected remedy are:

- Install an earth cover over the area of attainment at Hardfill No 1.

- Institutional controls to prevent future use of the area for residential use and/or limiting its use to industrial uses.

- Developing a long-term monitoring and maintenance plan for the hardfill.

The OU-12 remedial action included landfill coyer soil construction at three separate areas within the OU (Figure 4-12). In addition, three monitoring wells will be sampled and analyzed for VOCS, PAHs, and indicators. The one upgradient well will be sampled semi-annually and the two downgradient wells will be sampled annually.

4.1.13 Flightline Refueling Area

The remedial action selected for the flightline area is based on the need to meet the State of South Dakota petroleum release program. Remedial actions at the flightline refueling area consists of one ground water extraction well and one ground water extraction trench at Pump House No 1 and two ground water extraction wells at Pump House No. 2. Extracted ground water flows to the FRA Pump House No. 1 Treatment System.

4.1.14 Off-Base JP-4 south of Operable Unit 2

The remedial action selected for the JP-4 plume based on the need to meet the State of South Dakota petroleum release program. The JP-4 extraction system consists of ten dual phase (water/vapor) extraction wells. The wells were installed in 1996. The remedial strategy is to contain the plume and address hot sport s within the plume. The dual phase extraction wells were installed to recover free phase product, impacted ground water and soil vapor. Recovered ground water is pumped to the central treatment facility in Building 6908.

4.2 REMEDIAL ACTION IMPLEMENTATION

Information on the implementation of the remedies at each operable unit is summarized in Table 4-4.

4.3 OPERATION AND MAINTENANCE ACTIVITIES

Operation and maintenance activities and down time are summarized in Sections 4.3.1. 4.3.2 and 4.3.3. In addition to operation of pumping and extraction systems, implementation and/or modification of institutional controls is a part of the Base operation and maintenance program.

4.3.1 Operation and Maintenance Procedures

A System Operation and Maintenance (O&M) Plan is in place at Ellsworth Air Force Base which covers all operable units that contain active remediation systems. The following tasks are covered in the plans:

- Operating and maintaining the facilities within effluent limitations.
- Maintaining accurate O&M records.
- Completing and submitting required reports.
- Ordering supplies, chemicals, replacement parts, and other materials required for facility operation.

- Making regular rounds of facilities to ensure proper functioning of equipment.
- Operating and adjusting facilities equipment and making required process adjustments.
- Monitoring chemical storage tank levels.
- Performing preventative maintenance and cleaning duties on facility process equipment, building, and grounds.
- Performing preventive maintenance and cleaning duties on the ground water collection system (pumps, controls, and pipes); and the discharge system (controls and pipes).
- Drawing samples for laboratory analysis and performing limited process control testing.
- Maintaining and repairing process mechanical, electrical, and control equipment.
- Planning, coordinating, and participating in major equipment overhauls.
- Observing safety practices and be aware of chemical hazards, hazardous areas, and/or procedures.
- Maintaining good public relations.
- Maintaining/renewing proper treatment plant operator certification.
- Preparing budgets and annual reports.

TABLE 4-4

REMEDY IMPLEMENTATION
Ellsworth Air Force Base, South Dakota

Operable Unit	Date of ROD Signature	Remedial Design		REMEDIAL SYSTEM COMPONENTS	Construction Period		Average Ground Water Pumping Rates (gpd)	Mass Removal		Other Comments
		Start	Completion		Start	Completed		Air (lbs)	Ground Water (lbs)	
OU-1 IRA	August 1995	January, 1995	Junc, 1995	4DWs[1] 8 SVE[2] Wells 1 SVE Blower Remodeling of Building 6908 and conversion of building into a CTF[3] for treatment of contaminated soil vapor and groundwater. IC's	June, 1995	August 13, 1996	NA(3)	NA(3)	NA(3)	
OU-4 IRA	August 1995	January, 1995	July, 1995	7 Ews[5] IC's	June 1995	August 13, 1996	NA (3)	NA (3)	NA (3)	Offsite Ews (3) were installed in June 1997.
FRA Pumphouse No. 4-IRA	NA (1)	January, 1995	July, 1995	2 Ews IC's	June 1995	August 13, 1996	6,000	NA (4)	NA 4)	
FRA Pumphouse No. I-IRA	NA (1)	January, 1995	July, 1995	1 EW 1 Groundwater Extraction Trench Groundwater treatment building for treatment of contaminated groundwater. Ics	June 1995	August 13, 1996	8,000	NA (4)	NA (4)	
OU-1 Final Remedy (FR)	May 1996	November, 1995	June, 1996	9 EW's 7 DWs 1 Dual phase extraction trench 4 SVE wells Soil vapor extraction building Modifications to CTF Fencing to restrict access to OU IC's	July 1996	June 6, 1997	35,000	45,000	2,000	
		NA	NA	Biotreatment of soils.	August 1997	November 1997	NA (2)	NA (2)	NA (2)	
		NA	NA	Installation of PZs[6] and MWs for LT M[7].	August 1998	September 1998	NA (2)	NA (2)	NA (2)	
		NA	NA	Long-term monitoring program.	April, 1998	Ongoing	NA (2)	NA (2)	NA (2)	
OU-2	May 1996	November, 1995	April, 1996	Landfill cap. Fencing to restrict access to OU	June, 1996	May l, 1997	NA (2)	NA (2)	NA (2)	

Operable Unit	Date of ROD Signature	Remedial Design		REMEDIAL SYSTEM COMPONENTS	Construction Period		Average Ground Water Pumping Rates (gpd)	Mass Removal		Other Comments
		Start	Completion		Start	Completed		Air (lbs)	Ground Water (lbs)	
		November, 1995	April, 1996	Construction of drainage channel	June, 1996	October, 1996	NA (2)	NA (2)	NA (2)	
		October, 1996	June, 1997	LLRW[8] excavation and disposal	July, 1997	January, 1998	NA (2)	NA (2)	NA (2)	
		NA	NA	Chemical Weapons Material excavation and disposal	August, 1997	February, 1998	NA (2)	NA (2)	NA (2)	
				LTM program. IC's	April, 1997	Ongoing	NA (2)	NA (2)	NA (2)	
OU-2 JP-4	NA (1)	November, 1995	April, 1996	Offsite easement. 10 DWs in JP-4 Area. SVE blower building IC's	June 1996	December 1996	30,000	22,840	240	
				1 DW in JP-4 Area 3 SVE wells in JP-4 Area	February 1998		NA (3)	NA (3)	NA (3)	
OU-2 JP-8	NA (1)			JP-8 Excavation 2 SVE wells in JP-8	November, 1996	November, 1997	NA (3)	NA (3)	NA (3)	
OU-3	June 1996			Landfill Cap LTM Program IC's	June, 1996 April, 1997	May, 1997 Ongoing	NA (2)	NA (2)	NA (2)	
OU-4 FR	May 1996	November, 1995	July, 1996	Landfill Cap Property Acquisition 19 Ews Additional Investigation Fencing to restrict access to OU IC's	June 1996	December 1996	14,000	NA (2)	21	
				MWs and PZs for LTM	July 1998	September 1998	NA (2)	NA (2)	NA (2)	
				2 Ews MWs and PZ for LTM	September 1999	December 1999	NA (3)	NA(3)	NA(3)	
				LTM program.	April, 1997	Ongoing	NA (2)	NA (2)	NA (2)	
OU-5		November, 1995	June, 1996	Landfill Cap Fencing to Restrict Access to OU LTM Program ICs	June, 1996 April, 1997	May 1, 1997 Ongoing	NA (2)	NA (2)	NA (2)	
OU-6	October 1995	January, 1995	August, 1995	Landfill Cap Fencing to Restrict Access to OU	November, 1996	July, 1996	NA (2)	NA (2)	NA (2)	
				MWs to monitor effectiveness of cap.	July 1998	August 1998	NA (2)	NA (2)	NA (2)	
				LTM program. IC's	July, 1996	Ongoing	NA (2)	NA (2)	NA (2)	

Operable Unit	Date of ROD Signature	Remedial Design		REMEDIAL SYSTEM COMPONENTS	Construction Period		Average Ground Water Pumping Rates (gpd)	Mass Removal		Other Comments
		Start	Completion		Start	Completed		Air (lbs)	Ground Water (lbs)	
OU-7	June 1996	October, 1996	June, 1997	Removal of LLRW Monitoring wells for NA monitoring Monitored natural attenuation Monitoring IC's	August, 1997 October, 1998	January, 1998 Ongoing	NA (2)	NA (2)	NA (2)	
OU-8	June 1996	November, 1995	June, 1996	Placement of Soil Cover Long Term Monitoring Program IC's	June, 1996 April, 1997	June, 1997 Ongoing	NA (2)	NA (2)	NA (2)	
OU-9	May 1996	NA	NA	No Action ROD IC's	NA	NA	NA (2)	NA (2)	NA (2)	
OU-10	May 1996			No Action ROD IC's			NA (2)	NA (2)	NA (2)	
OU-11 Off-Base	April 1997	July, 1998	September, 1998	Off-Base water line Additional investigation (AOC 24) LTM program Installation of MWs to monitor plume IC's	September, 1998 September, 1997	Ongoing Ongoing	NA (2)	NA (2)	NA (2)	
OU-11 BG04 Base Boundary		November, 1996	June, 1997	Installation of 4 Ews Installation of groundwater re-injection gallery Installation of groundwater treatment building IC's	April, 1997	January 1998	33,000	NA (2)	10	
				Installation of MWs and PZs to monitor extraction system performance	April, 1997	December, 1999	NA (2)	NA (2)	NA (2)	
OU-11 BG05 Base Boundary		November, 1996	June, 1997	Installation of 3 Ews Installation of groundwater re-injection gallery Installation of groundwater treatment building IC's	April, 1997	January 1998	55,000	NA (2)	6	
				Installation of MWs and PZs to monitor extraction system performance Installation of 4th EW	April, 1997	January, 2000	NA (3)	NA (3)	NA (3)	
OU-11 BG04 West		November, 1996	March, 1997	Installation of 4 Ews Installation of groundwater treatment building IC's	April, 1997	January 1998	29,000	NA (3)	19	

Operable Unit	Date of ROD Signature	Remedial Design		REMEDIAL SYSTEM COMPONENTS	Construction Period		Average Ground Water Pumping Rates (gpd)	Mass Removal		Other Comments
		Start	Completion		Start	Completed		Air (lbs)	Ground Water (lbs)	
OU-11 South Docks Main		November, 1996	March, 1997	Installation of 6 Ews Installation of 4 DWs Modification of the Pumphouse No. 1 treatment building SVE blower IC's	April, 1997	January 1998	140,000	60	2,860	SVE portion of DWs taken off line.
OU-11 30 Row		November, 1996	March, 1997	Installation of 3 Ews IC's	April, 1997	January 1998	NA (3)	NA (3)	NA (3)	
OU-11 50 Row		November, 1996	March, 1997	Installation of 3 Ews IC's	April, 1997	January 1998	NA (3)	NA (3)		
OU-11 Building 102		November, 1996	March, 1997	Installation of 9 WPs Installation of vacuum and transfer pumps in a concrete vault IC's	April, 1997	January 1998	25,000	NA	600	
OU-11 Pride Hangar		November, 1996	March, 1997	Installation of 9 WPs Installation of vacuum and transfer pumps in a concrete vault IC's	April, 1997	January 1998	63,000	NA	<30	
OU-11 North Docks 60 ROW	NA (1)	November, 1996	June, 1997	5 WPs Vacuum pump Mobile treatment system IC's	May, 1997	November, 1998	1,200			
OU-12	May 1996	November, 1995	June, 1996	Earthen cover over hard fill LTM program IC's	June, 1996 April, 1997	May 1, 1997 Ongoing	NA (2)	NA (2)	NA (2)	

DWs = dual extraction well, w/soil vapor extraction and ground water extraction systems installed
SVE = soil vapor extraction well
CTF = central treatment facility
lcs = institutional controls
Ews = ground water extraction well
PZs = piezometer well
LTM = long term monitoring
LLRW = low level radiological waste
WPs = vacuum dewatering well points
NA = Not Applicable
NA (1) = Not Applicable – Non CERCLA Action

NA $_{(2)}$ = Not Applicable – No Soil Vapor/Groundwater is extracted
NA $_{(3)}$ = Not Applicable – Components incorporated into existing system
NA $_{(4)}$ = Not Applicable – IRA incorporated into Final Remedy System

Four positions are staffed in order to perform these tasks. The position titles are Site Manager, Lead Operator, Operations Manager/Chemist, and Operating and Maintenance Technician. All operators have completed the 40-hour health and safety training required by OSHA 29 CFR 1910.120 and annual health and safety refresher courses as needed. Additional training is provided to O&M staff as needed.

A review of the O&M manuals and procedures indicates that all manuals are appropriate for the systems installed and that all the procedures provide adequate guidance for the O&M of the systems. The O&M manuals were updated in early 2000.

4.3.2 System Operation and Optimization

A LTM QAPP has been implemented for the purpose of monitoring ground water quality at Ellsworth Air Force Base. The plan outlines monitoring wells, sampling points, analytical parameters, and sampling schedule for all the Operable units at Ellsworth Air Force Base. Landfill cover inspections are also covered in this plan. Results of the ground water sampling and landfill cover inspections are summarized in Long Term Monitoring Reports submitted to the USACE, Air Force, SDDENR, and EPA on a quarterly basis or as outlined in the SAP.

The LTM QAPP for Ellsworth Air Force Base is periodically reviewed by the Oversight Group. Changes are periodically made in the SAP based on results from previous sampling events or due to changing conditions. The SAP was last updated in July2000.

4.3.3 Summary of System Downtime and Operation and Maintenance Issues

Table 4-5 summarizes all major system downtime and operation and maintenance issues.

TABLE 4-5

SUMMARY OF OPERATIONAL DOWNTIME AND OPERATIONS AND MAINTENANCE ISSUES
Ellsworth Air Force Base, South Dakota

Operable Unit		Problem Description	Resolution	Date of Identification	Date of Resolution	Notes/Comments
OU-1	Wellfield	1. Biosolids from EW and DW wells were fouling treatment equipment in CTF. 2. Inadequate number placement of wellfield monitoring points 3. Low flows from wellfield 4. Problems with pumps and controllers 5. Potable waterline break repair resulted in wellfield shut-down 6. Motor starters burned up at extraction wells	1. Reconditioned two wells with acid in 1998, redeveloped rest of well field in '98 and 2000 2. Added monitoring points to monitoring network 3. See above note 4. Ongoing maintenance/preventative maintenance program 5. Repaired waterline and re-started well field 6. Replaced motor starters at 16 wells	1. 6/98 & 2/00 2. 7/98 3. On-going 4. 7/21/99 5. 1/27/99	1. 9/98 & 2/00 2. 9/98 3. On-going 4. 7/29/99 5. 2/5/99	1. Well field trends are continually being monitored to determine when well redevelopment is needed
	6908 CTF	1. Selenium exceedance in plant effluent 2. SVE Blower damaged due to scale build-up in blower housing 3. Problem with communication and controls between 6908 and FRA-PH4 4. Problems with air stripper blower motor	1. Increased frequency of plant effluent sampling, investigated wellfields, shut down selected wells intermittently 2. Repaired blower, revised inspection schedule 3. Checked cable splices, replaced a section of cable, completed controls changes 4. Repaired air stripper blower motor	1. Plant start-up 2. 2/23/98 3. 7/98 4. 6/20/99	1. On-going 2. 5/28/98 3. 6/4/99 4. 6/25/99	1. FRA-PH4, 1/10/99 to 1/19/00 for Honeywell controls chang-out 2. JP-4, 1/14/00 to 1/21/00 for Honeywell controls change-out 3. 6908 CTF, 1/11/99 to 1/25/00 for Al Winland incident. 4. Site was down from 5/18/99 to 6/4/99, problem with controls displaying incorrect site status from 7/98 to 6/4/99
OU-2	Landfill Cap	Minor erosion in cover and along west ditch	Erosional areas repaired	4/99	10/99	
	JP-4 Site	1. DWJP06 damaged (near free product plume) 2. 2. Problem with communication system between 6908 CTF and blower building	1. Used DWJP06 as temporary SVE well 2. Replace portion of communication cable, replaced modem at JP-4 site	1. 7/97 2. 7/9/98	1. 3/98 2. 9/23/98	2. Site was operated during manned hours during problem period
	JP-8 Spill Site	JP-8 spill immediately south of OU-2 landfill	Excavated all accessible contaminated soil, installed two SVE wells to cleanup residual soil contamination, conected to JP-4 SVE			Remediation completed and wells were taken off line
OU-3	Landfill Cap	Landslide from OU-5 affects north edge of cover	Repairs planned	2/00	Ongoing	
OU-4	Landfill Cap	None noted.				
	Wellfield	1. Low flows from wellfield	1. Redeveloped several extraction wells in 1998 and 2000	1. 6/98 & 2/00 2. 2. 9/99	1. 9/98 & 7/00 2. 1/5/00	
OU-5	Landfill Cap	Landfill cover subsidence and landslide	Repaired subsidence cracks in cover two times in 1997 and 1998	10/96	Ongoing	Significant landslide observed in 8/99, repairs are planned
OU-6	Landfill Cap	None noted.				
OU-7	Ground Water Monitoring	Plume expanding	Continued monitoring		Ongoing	Edge of Plume is not near base boundary

Operable Unit		Problem Description	Resolution	Date of Identification	Date of Resolution	Notes/Comments
OU-8	Landfill Cap	Soil cover disturbed by Air Force personnel during ordnance disposal activities	Soil cover repaired, new signaage, restricted area map developed, training, Base Continuing Order Reissued	9/99	10/99	
OU-9		No action ROD.				
OU-10		No action ROD.				
OU-11	Pump house No. 1 Treatment Building	1. Problem with oil/water separator transfer pump short-cycling 2. Problem with solids from transfer piping passing through process equipment when Pride Hangar system operated with more than one transfer pump	1. Converted oil/water separator to a reservoir which reduced cycle frequency of the transfer pump 2. Placed franc tank in treatment system to drop out solids from transfer piping, removed bag filter system and carbon units from treatment process	1. Start-up 2. 12/97	1. 12/1/98 2. 2/18/99	1. Hole was cut in the oil/water separator interior wall to convert it to a reservoir, no free product had been collected from the system since start-up 2. Frac tank in place from 10/14/98 to 12/1/98, removed bag filter system and carbon units from treatment process on 2/18/99
	South Docks Main	Problem with SD SVE heater contactor caused building to freeze and transfer pump to crack	Replaced transfer pump and replaced heater contactor	3/10/98	4/8/98	
	30 ROW	None noted.				
	50 ROW	None noted.				
	Building 102 Vacuum Pump	1. Problem with transfer pumps overheating 2. Problem with vacuum pump motor	1. Inspected motors, serviced pumps 2. Replaced motor	1. 6/25/99 2. 5/20/00	1. 7/5/99 2. 6/6/00	2. Problem with pumps observed to occur with high ambient air temperatures
	Building 102 Wellfield	None noted.				
OU-11	Pride Hangar Vacuum Pump	1. System operated with only one transfer pump due to problems at FRA-PH1 treatment plant when more than one transfer pump operated 2. Problem with vacuum pump motor	1. Place frac tank in treatment system to drop out solids from transfer piping to allow Pride Hangar system to operate with more than one transfer pump 2. Repaired motor two times	1. Start-up 2. 7/6/99	1. 10/14/98 2. 8/31/99	1. Site able to operate with more than one transfer pump after frac tank was placed on 10/14/98, the frac tank was removed on 12/1/98 2. Site was down from 7/6/99 to 7/29/99 and 8/4/99 to 8/31/99, intermittent operation from 7/29/99 to 8/4/99
	Pride Hangar Wellfield	Wellpoint SDPHWP01 was damaged by contractor	Wellpoint was replaced	1/99	7/99	
	BG04 West Treatment System	Problem with motor for air stripper transfer pump and motor starter for transfer pump	Replaced electrical components including motor starter, repaired transfer pump motor	3/16/00	4/28/00	Site was down from 4/16/00 to 4/28/00, intermittent operation from 3/16/00 to 4/16/00
	BG04 West Wellfield	None noted.				
	BG04 Base Boundary Treatment System	None noted.				
	BG04 Base Boundary Wellfield	None noted.				
	BG05 Base Boundary Treatment System	None noted.				
	BG05 Base Boundary Wellfield	None noted.				
	AOC 24	None noted.				
OU-12	Landfill Cap	None noted.				

5.0 5-YEAR REVIEW PROCESS

5.1 TEAM MEMBERS

Installation Restoration Program (IRP) Team members who prepared the five-year review included the following:

Dell Petersen, IRP Chief, Ellsworth AFB
Carol Stark, Program Manager, Headquarters/Air Combat Command
Gary Schmidt, Ellsworth AFB IRP
Len Havel, US Corps of Engineers, Omaha District
Mark Mercier, US Corps of Engineers, Omaha District
Keith Anderson, Earth Tech/contractor
Joe Odegaard, Earth Tech/contractor
Robert Todd, RD Todd & Associates/contractor

The time period covered by the five-year review was generally from the inception of the remedial investigations in 1993 through June, 2000.

5.2 DOCUMENT REVIEW

During this 5-year review a number of EAFB RI/FS program primary documents were reviewed and relied upon of information. Table 5-1 provides a summary of those documents.

TABLE 5-1

DOCUMENTS REVIEWED DURING THE EAF+--B 5-YEAR REVIEW PROCESS

Final Remedial Investigation Report Operable Unit 01 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 02 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 03 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 04 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 05 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 06 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 07 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 08 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 09 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 10 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 11 at Ellsworth Air Force Base, South Dakota
Final Remedial Investigation Report Operable Unit 12 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 01 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 02 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 03 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 04 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 05 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 06 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 07 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 08 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 09 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 10 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 11 at Ellsworth Air Force Base, South Dakota
Final Feasibility Study Report Operable Unit 12 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 01 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 02 at Ellsworth Air Force Base, South Dakota

Final Record of Decision for Remedial Action at Operable Unit 03 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 04 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 05 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 06 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 07 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 08 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 09 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 10 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 11 at Ellsworth Air Force Base, South Dakota
Final Record of Decision for Remedial Action at Operable Unit 12 at Ellsworth Air Force Base, South Dakota
U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A). Interim Guidance. Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/022.
U.S. Environmental Protection Agency (USEPA). 1989. Exposure Factors Handbook. Office of Human Health and Environmental Assessment, Washington, D.C. EPA/600/8-89/043.
U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund, Volume II: Human Health Evaluation Manual (Part A). Interim Guidance. Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/001
U.S. Environmental Protection Agency (USEPA). 1989. Ecological Assessment for hazardous Waste Sites: A field and Laboratory Reference. EPA/600/3-89/013.
U.S. Environmental Protection Agency (USEPA). 1993. Integrated Risk Information System (IRIS). U.S. EPA Office of Research and Development, Washington, D.C.
U.S. Environmental Protection Agency (USEPA). 2000. Integrated Risk Information System (IRIS). U.S. EPA Office of Research and Development, Washington, D.C. http://www.epa.gov.iris.

5.3 SITE VISITS AND INSPECTIONS

The team conducted site visits during the week of March 19, 2000. During this time, the team visited each of the operable units and the ground water/soil vapor treatment facilities that serve the operable units.

5.4 DOCUMENTATION OF PUBLIC NOTICES

The Air Force published a notice in the Rapid City Journal on June 7th , 8th and 9th 2000. The notice is contained in Appendix D. The notice stated that a five year review of the IRP was being undertaken by the Air Force and invited input from citizens.

5.5 5-YEAR REVIEW TASKS

- Review RI/FS documents for operable unit background information, human health and ecological risk assessments and remedial action evaluations.

- Review ROD documents for documentation of the selection of the final remedial action.

- Review EPA guidance on Human health and Ecological Risk Assessments for changes and current applicability.

- Review ARARS and TBCs criteria used in evaluation of the remedial actions for the Operable Units for changes and current applicability to OUs.

- Compare completed remedial actions to those outlined in RODS.

6.0 5-YEAR REVIEW FINDINGS

6.1 CHANGES IN STANDARDS AND TO BE CONSIDERED CRITERIA

The principal standards applied to the remedial action process at EAFB were based on the Applicable or Relative and Appropriate Requirements (ARAR). Table 6-1 provides a summary of the ARARS reviewed for applicability to EAFB during the RI process. This list contains chemical, action. and location specific standards determined to be ARARs for EAFB. Chemical specific standards or criteria that have changed since the first ROD was signed at EAFB are summarized in Tables 6-2 through 6-4. Chemical standards for surface water, ground water and soil media for a limited number of analytes have changed. Those changes affect the cleanup criteria for petroleum related compounds reported as Total Petroleum hydrocarbons (TPH). The State of South Dakota TPH Tier I trigger level changed from 10-100 mg/kg to 500 mg/kg. The result of these changes is that generally lower concentrations of some organic and inorganic contaminants may be considered as acceptable action or cleanup levels at EAFB. The State of South Dakota TPH level is not a cleanup standard but a screening level to be used to determine of additional investigation or other actions will be needed at a site. No changes were identified in the location and action specific ARARs.

6.2 CHANGES IN EXPOSURE PATHWAYS

The exposure pathways evaluated for each OU at EAFB are summarized in Tables 6-5 through 6-8. The evaluations considered on-site and off-site exposures based on current and future landuse. These pathways are still appropriate for use in evaluation of the site and no changes are warranted. The exposure scenarios used are conservative and probably represent a greater potential average (normally expected) exposure. than actual exposures. As an example for landfills with earthen covers that must be mowed as part of routine maintenance. it was assumed that the covers would be mowed 6 times per year. In actual practice the covers are mowed at a less frequent rate (once or twice per year), thus the estimated potential risk is greater than actual risk.

The most significant change in exposure pathways is the evidence of a completed ground water pathway off-Base at OU-11. When the OU-11 human health risk assessment was completed no sampling had been completed off-Base to the east of the Base boundary in the northeast area of the Base. This area has been referred to as AOC-24 and the BG-04 area. Subsequent investigations have shown an extensive area where ground water leaving the Base has carried TCE off-Base. This area was investigated and is undergoing remediation as part of the OU-11 Basewide Ground Water Remedial Action.

The verification of a completed ground water pathway at OU- 11 and the current conditions at other OUs do not affect the protectiveness of the selected remedy, and therefore no additional evaluations are warranted regarding pathways under current conditions.

No completed exposure pathway has been identified for the flightline refueling area or the JP-4 plume area.

6.3 TOXICITY AND OTHER CONTAMINANT CHARACTERISTICS

Table 6-9 provides a summary of the chemicals of concern (COCs) that resulted in remedial action being recommended for various OUs at EAFB. As noted in Table 6-9 six OUs (3, 5, 6, 7, 10, and 12) did not have COCs reported in concentrations at a level that would require chemical specific remedial actions being implemented at the OU. For the most part these OUs received remedial actions based on action

specific criteria needed to provide for adequate soil coyer on previously closed landfill areas. The soil exposure remedy applied at OUs 2, 3, 4, 5, 6, 8, and 12 was based on the application of EPAs Presumptive Remedy for Municipal Landfills, and was not specific for a COC.

Five COCs have had toxicity value or limits revisions since the RODs were completed for EAFB. Those chemicals are summarized in Table 6-10. The change in the standards or chemical toxicity of the organic analytes in ground water is not expected to affect the protectiveness of the remedial actions applied at specific OUs. The current technologies applied are expected to remove the COCs to the levels identified as cleanup goals. One possible exception is the criteria for gamma chlordane (identified in ground water samples at OU-11), which is now twenty fold lower than the previous criteria. No specific remedial action was initiated for this COC, additional monitoring may be needed to determine if this chemical poses an environmental risk. Gamma chlordane is a broad-spectrum insecticide and was used extensively in agriculture and for termite control in the 1980s, since that time its use has been restricted and EPA has issued a no use restriction on food products.

No changes in chemical toxicity values were reported for COCs at the flightline refueling area of the JP-4 plume area.

TABLE 6-1

FEDERAL AND STATE ARARS THAT WERE APPLIED TO ELLSWORTH AFB, SOUTH DAKOTA

A. Potentially Applicable or Relevant and Appropriate Federal Standards, Requirements, Criteria and Limitations

Standard Requirement, Criteria, or Limitation	Citations	Description	ARAR Type	Applicability to EAFB
Safe Drinking Water Act of 1986	42 USC 300g			
National Primary Drinking Water Standards	40 CFR Part 141.11-12	Specifies maximum chemical contaminant levels (MCLs) of public water systems.	Chemical	Relevant and appropriate for Federal Class II aquifer.
National Secondary Drinking Water Standards	40 CFR Part 143.03	Establishes secondary maximum contaminant levels (SMCLs) for public water systems. These are federally non-enforceable standards, which regulate contaminants in drinking water that primarily affect the qualities.	Chemical	Relevant and appropriate.
Maximum Contaminant Level Goals	40 CFR Part 141.50 & Pub. L. No. 99-330, 100 Stat. 642 (1986)	Establishes drinking water quality goals set at levels of unknown or anticipated adverse health effects, with an adequate margin of safety.	Chemical	Relevant and appropriate.
Clean Water Act of 1977	33 USC 1251-1376			
Water Quality Criteria	40 CFR Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	Chemical	Relevant and appropriate. Aquifer may be a Federal Class IIA (discharge to surface water).
Criteria and Standards for the National Pollutant Discharge Elimination	40 CFR 125.1-3	Establishes criteria and standards for technology-based requirements in permits under the Sections 301(b) and 402 of the CWA.	Chemical	Applicable for groundwater treated and discharged to EAFB WWTP in future.
General Pretreatment Regulations for Existing and New Sources of Pollution	40 CFR 403.1-4, 8-11, 1B	Establishes responsibilities of federal, state, and local government and of the POTW in providing guidelines for and developing, submitted, approving, and modifying state pretreatment programs.	Action	Applicable for groundwater treated and discharged to EAFB WWTP in future.
	40 CFR 403.5-7, 13, 15	Specifies standards for pretreatment.		
Guidelines Establishing Test Procedures for the Analysis of Pollutants	40 CFR 136.1-5 and Appendices A-C	Specifies analytical procedures for NPDES applications and reports.	Action	Applicable for any future treatment and discharge of ground water.

Standard Requirement, Criteria, or Limitation	Citations	Description	ARAR Type	Applicability to EAFB
Clean Air Act of 1983	42 USC 7401			
National Primary and Secondary Ambient Air Quality Standard	40 CFR Part 50.1-6, 8, 9, 11, 12, and Appendices A, H, J, K	Establishes national primary and secondary ambient air quality standards to protect public health and welfare.	Action	Applicable
National Emission Standards for Hazardous Air Pollutants	40 CFR Part 61.01	Establishes regulatory standard for specific air pollutants.	Action	Applicable for alternatives that would discharge to the air following treatment.
Solid Waste Disposal Act as amended by Resource Conservation and Recovery Act of 1976	42 USC 6901			
Solid Waste Disposal Facility Criteria	40 CFR Parts 257 and 258	Sets forth revised minimum federal criteria for Municipal Solid Waste Landfills (MSWLFs) for existing and new units.	Action	Relevant and appropriate for addressing landfill closure performance standards.
Land Disposal Restrictions	40 CFR Part 268	Identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which a prohibited waste may continue to be land disposed.	Action	Relevant and appropriate. Alternatives may include the disposal of residual waste due to treatment.
Guidelines for the Land Disposal of Solid Waste	40 CFR Part 241.100-213	Establishes requirements and procedures for the disposal of solid waste.	Action	Relevant and appropriate for meeting landfill closure performance guidelines.
Resource Conservation and Recovery Act of 1976				
Hazardous Waste Management System: General	40 CFR Part 260	Establishes definitions as well as procedures and criteria for modification or revocation of any provision in 40 CFR Parts 260-265.	Action	Applicable for identifying hazardous waste during soil placement at landfills at EAFB.
Identification and Listing of Hazardous Wastes	40 CFR Part 261	Defines those solid wastes which are subject to regulations as hazardous wastes under 40 CFR Parts 262-265.	Action	Applicable for identifying hazardous waste during soil placement at landfills at EAFB.
Standards Applicable to Generators of Hazardous Wastes	40 CFR Part 262	Establishes standards for generators of hazardous waste	Action	Applicable to alternatives relating to removal or offsite transport of a hazardous material.
Standards Applicable to Transporters of Hazardous Wastes	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262	Action	Applicable for any transport of hazardous materials offsite.
Standards for Owners and Operators of	40 CFR Part 264	Establishes standards for acceptable	Action	Relevant and Appropriate for

Standard Requirement, Criteria, or Limitation	Citations	Description	ARAR Type	Applicability to EAFB
Hazardous Waste TSDF's		hazardous waste management.		Performance guidelines for landfill closure
Standards for Owners and Operators of Hazardous Waste TSDF's with Interim Status	40 CFR Part 265	Establishes standards for acceptable hazardous waste management during interim status	Action	Relevant and Appropriate for performance guidelines for landfill closure.
Toxic Substances Control Act (TSCA)	40 CFR Part 761.1	Substances regulated under this rule include, but are not limited to, soils and other materials contaminated as a result of spills	Action	Applicable
Fish and Wildlife Coordination Act	16 USC 1531-666 40 CFR 6,302 (g)	Requires consultation when a federal department or agency proposes or authorizes any modification of a stream or other water body and adequate provision for protection of fish and wildlife resources	Action	Not an ARAR.
Endangered Species Act	16 USC 1531-1543 50 CFR Parts 17, 402 40 CFR 6.302 (g)	Requires that Federal agencies insure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat	Location/Action	Not an ARAR. Ecological Assessment did not identify EAFB as having critical habitat or endangered species.
Archaeological and Historic Preservation Act	16 USC 469 40 CFR 6.301©	Establishes procedures to provide for preservation of historical and archaeological data, which might be destroyed through alteration of terrain as a result of federal construction project for a federal licensed activity or program.	Location	Potential ARAR. On-Base property was used for landfilling activities. No known historic or archaeological value, although no confirmation study has been performed.
Archaeological Resources Protection Act (1979)	93 Stat. 721 16 USC 470	Requires a permit for an excavation or removal of archaeological resources from public or Indian land.	Action/Location	Not an ARAR.
Executive Order 11,958 on Floodplains Management	42 USC 7401 40 CFR 6.302 (b) & Appendix A	Requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, the adverse impacts associated with direct and indirect development of a floodplain	Location	Not an ARAR. Area not in 100-year floodplain.
Executive Order on Protection of Wetlands	Exec. Order No. 11,990 40 CFR 6.302(a) & Appendix A	Requires federal agencies to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.	Action/Location	Applicable. EAFB has identified wetland areas adjacent to sites where Ras were complete.

Standard Requirement, Criteria, or Limitation	Citations	Description	ARAR Type	Applicability to EAFB
B. Potentially Applicable or Relevant and Appropriate State Standards, Requirements, Criteria, and Limitations				
South Dakota Air Pollution Control Regulations	74:26:01:09,24,25,26-28	Establishes permit requirements for construction, amendment, and operation of air discharge services.	Action	Applicable
South Dakota Waste Management Regulations	74:26:03:04	Establishes requirements for disposal of hazardous waste in sanitary landfills.	Action	Relevant and appropriate for landfill closure performance guidelines.
South Dakota Waste Management Regulations	74:27:03:11	Defines requirements for closure of solid waste disposal facilities.	Action	Relevant and appropriate for landfill closure performance guidelines.
South Dakota Waste Management Regulations	74:27:09:06	Defines criteria for permit application for other solid waste TSD facilities	Action	Not an ARAR
South Dakota Waste Management Regulations	74:27:15	Establishes standards for landfill closure and postclosure monitoring	Action	Relevant and appropriate
South Dakota Waste Management Regulations	74:28:24:01	Establishes standard for transporters of waste	Action	Relevant and appropriate
South Dakota Water Discharge Permit Rules	74:03:18:01-17	Establishes surface water discharge permit applications requirements	Action	Not an ARAR unless future groundwater treatment required
South Dakota Water Discharge Permit Rules	74:03:19:01-08	Establishes surface water permit conditions	Action	Not an ARAR unless future groundwater treatment required
South Dakota Water Discharge Permit Rules	74:03:01	Establishes requirements for individual and small onsite wastewater systems	Action	Not an ARAR unless future groundwater treatment required
South Dakota Water Quality Standards	74:03:04:02,10	Defines use of Box Elder Creek and certain tributaries	Action	Not an ARAR unless future groundwater treatment required
South Dakota Remediation Criteria for Petroleum-Contaminated Soils	74:03:32	Establishes requirements for the remediation of soil contaminated with petroleum products.	Chemical	Relevant and appropriate for evaluating acceptable levels of petroleum products in the soil.
South Dakota Ground Water Standards	74:03:15	Defines ground water classifications by beneficial use and sets chemical standards.	Chemical	Relevant and appropriate in evaluating the beneficial use of impacted groundwater.

TABLE 6-2

CHANGES IN CHEMICAL SPECIFIC STANDARDS

Contaminant	Media	Cleanup Level	Standard (ug/L)		Source/Year
BHC (alpha)(Hexachlorocyclohexane-alpha)	Surface Water	NA	Previous	0.031	SDSWQC 1996[1]
			New	0.013	SDSWQC 1998[2]
BHC (beta) (Hexachlorocyclyhexane-beta)	Surface Water	NA	Previous	0.063	SDSWQC 1996
			New	0.046	SDSWQC 1998
BHC (gamma) (Lindane)	Surface Water	NA	Previous	0.096	SDSWQC 1996
			New	0.063	SDSWQC 1998
Pentachlorophenol	Surface Water	NA	Previous	20/13[3]	SDSWQC 1996
			New	20/3	SDSWQC 1998
Lead	Surface Water	NA	Previous	82/3.2	SDSWQC 1996
			New	65/2.5	SDSWQC 1998
Mercury	Surface Water	NA	Previous	2.4/0.012	SDSWQC 1996
			New	2.1/0.012	SDSWQC 1998

Contaminant	Media	Cleanup Level	Standard (ug/L)		Source/Year
Benzene	Soil	NA	Previous	NA	SDRCPCS 1995[4]
			New	0.2	SDRCPCS 1995[5]
Total Petroleum Hydrocarbons	Soil	NA	Previous	10-100	SDRCPCS 1995
			New	500	SDRCPCS 1999

Contaminant	Media	Cleanup Level	Standard (ug/L)		Source/Year
Benzene	Ground Water	NA	Previous	0.005	USEPA IRIS 1991
			New	0.001	USEPA IRIS 2000
1,1-DCE	Ground Water	NA	Previous	0.007	USEPA IRIS 1994
			New	0.00006	USEPA IRIS 1998
TPH	Ground Water	NA	Previous	10	SDRCPCS 1995
			New	500	USEPA IRIS 2000
JP-4	Ground Water	NA	Previous	10	SDRCPCS 1995
			New	500	USEPA IRIS 2000
Gamma chlordane	Ground Water	NA	Previous	0.002	SDRCPCS 1995
			New	0.0001	USEPA IRIS 1998

[1]- South Dakota Surface Water Quality Criteria 1996
[2]- South Dakota Surface Water Quality Criteria 1998
[3]- Acute/Chronic ug/L
[4]- South Dakota Remediation Criteria for Petroleum Contaminated Soils 1995
[5]- South Dakota Remediation Criteria for Petroleum Contaminated Soils 1999

TABLE 6-3

CHANGES IN ACTION SPECIFIC STANDARDS

Action	Requirements		Prerequisite	Citation/Year
	Previous	None		
	New			

TABLE 6-4

CHANGES IN LOCATION SPECIFIC STANDARDS

Location	Requirements		Prerequisite	Citation/Year
Wetland	Previous	None		
	New			

TABLE 6-5

SUMMARY OF EXPOSURE PATHWAYS EVALUATED FOR THE HUMAN HEALTH RISK ASSESSMENT FOR CURRENT ON-SITE LANDUSES AT EAF

Y=pathway complete NA=pathway not applicable to site N=pathway not completed at site

EXPOSURE PATHWAYS	OU-1	OU-2	OU-3	OU-4	OU-5	OU-6	OU-7	OU-8	OU-9	OU-10	OU-11	OU-12
CURRENT ON SITE USES							Chem./ rad.					
Commercial/Industrial Land Use.												
GROUND WATER												
Ingestion	N	N	N	N	N	N	N/Y	N	N	N	N	N
SURFACE SOIL												
Ingestion	Y	Y	N	Y	Y	Y	Y/Y	Y	Y	Y	N	Y
Dermal Contact	Y	Y	N	Y	N	Y	Y/N	Y	Y	Y	N	Y
Inhalation			N	N	N	N	N/N	Y	Y	N	N	N
External	NA	NA	NA	NA	NA	NA	NA/Y	NA	NA	NA	NA	NA
SUBSURFACE SOIL												
Ingestion	N	N	N	N	N	N	N/N	N	Y	N	N	N
Dermal Contact	N	N	N	N	N	N	N/N	N	Y	N	N	N
Inhalation	N	N	N	N	N	N	N/N	N	N	N	N	N
External	NA	NA	NA	NA	NA	NA	NA/N	NA	NA	NA	NA	NA
SURFACE WATER												
Ingestion	N	N	N	N	N	Y	N/N	N	N	N	N	N
Dermal Contact	Y	N	N	N	N	Y	N/N	N	Y	N	N	N
Inhalation	Y	N	N	N	N	Y	N/N	N	N	N	N	Y
External	NA	NA	NA	NA	NA	NA	NA/N	NA	NA	NA	NA	NA
SEDIMENT												
Ingestion	Y	N	N	N	N	Y	N/N	N	Y	N	N	N
Dermal Contact	N	N	N	N	N	N	N/N	N	N	N	N	N
Inhalation	N	N	N	N	N	N	N/N	N	N	N	N	N
External	NA	NA	NA	NA	NA	NA	NA/N	NA	NA	NA	NA	NA
AIR												
Inhalation	Y	N	N	N	N	Y	N/N	Y	Y	N	N	Y
FAUNA												
Ingestion of fish/game	N	N	N	N	N	N	N/N	N	Y	N	N	N

TABLE 6-6

SUMMARY OF EXPOSURE PATHWAYS EVALUATED FOR HUMAN HEALTH RISK ASSESSMENT FOR CURRENT OFF-SITE LANDUSES AT EAFB

Y=pathway complete NA=pathway not applicable to site N=pathway not completed at site

EXPOSURE PATHWAYS	OU-1	OU-2	OU-3	OU-4	OU-5	OU-6	OU-7	OU-8	OU-9	OU-10	OU-11	OU-12
CURRENT OFF-SITE USES							Chem./Rad.					
Residential/Agricultural Land Use.												
GROUND WATER												
Ingestion	N	N	N	Y		N	N/N	N	N	N	N	N
Inhalation	N	N	N	Y		N	N	N	N	N	N	N
SURFACE SOIL												
Ingestion	N	N	N	N		N	N	N	N	N	N	N
Dermal Contact	N	N	N	N		N	N	N	N	N	N	N
Inhalation	N	N	N	N		N	N	N	N	N	N	N
External Exposure	NA	NA	NA	NA	NA	NA	N	NA	NA	NA	NA	NA
SUBSURFACE SOIL												
Ingestion	N	N	N	N		N	N	N	N	N	N	N
Dermal Contact	N	N	N	N		N	N	N	N	N	N	N
Inhalation	N	N	N	N		N	N	N	N	N	N	N
SURFACE WATER												
Ingestion	N	N	N	N		N	N	N	N	N	N	N
Dermal Contact	N	N	N	N		N	N	N	N	N	N	N
Inhalation	N	N	N	N		N	N	N	N	N	N	N
SEDIMENT												
Ingestion	N	N	N	N		N	N	N	N	N	N	N
Dermal Contact	N	N	N	N		N	N	N	N	N	N	N
Inhalation	N	N	N	N		N	N	N	N	N	N	N
AIR												
Inhalation	N	N	N	N		N	N	N	N	N	N	N
FAUNA												
Ingestion of fish/game	N	N	N	N		N	N	N	N	N	N	N

TABLE 6-7

SUMMARY OF EXPOSURE PATHWAYS EVALUATED FOR HUMAN HEALTH RISK ASSESSMENT FOR FUTURE ON-SITE LANDUSE AT EAFB

Y=pathway complete NA=pathway not applicable to site N=pathway not completed at site

EXPOSURE PATHWAYS	OU-1	OU-2	OU-3	OU-4	OU-5	OU-6	OU-7	OU-8	OU-9	OU-10	OU-11	OU-12
FUTURE ON-SITE USES							Chem./Rad					
On-Site Residential Land Use.												
GROUND WATER												
Ingestion	Y	Y	Y	Y	Y	Y	Y/Y	Y	Y	Y	Y	Y
Dermal Contact	Y	Y	Y	Y	Y	Y	Y/N	Y	Y	Y	Y	Y
Inhalation	Y	Y	Y	Y	N	Y	Y/N	Y	Y	Y	Y	Y
External	NA	NA	NA	NA	NA	NA	NA/N	NA	NA	NA	NA	NA
SURFACE SOIL												
Ingestion	Y	Y	Y	Y	Y	Y	Y/Y	Y	Y	Y	N	Y
Dermal Contact	Y	Y	Y	Y	N	Y	Y/N	Y	N	Y	N	Y
Inhalation	Y	N	N	N	N	N	N/N	N	Y	N	N	N
External	NA	NA	NA	NA	NA	NA	NA/N	NA	NA	NA	NA	NA
Ingestion of homegrown produce	NA	N	N	N	N	N	N/N	N	N	N	N	N
SUBSURFACE SOIL												
Ingestion	N	Y	Y	Y	Y	Y	Y/Y	Y	Y	Y	N	Y
Dermal Contact	Y	N	N	N	N	N	N/N	N	N	N	N	N
Inhalation	Y	Y	Y	Y	N	Y	Y/N	N	Y	Y	N	Y
External	NA	NA	NA	NA	NA	NA	NA/Y	N	NA	NA	NA	NA
SURFACE WATER												
Ingestion	Y	Y	N	N	N	Y	Y/Y	N	Y	N	N	Y
Dermal Contact	Y	Y	N	N	N	Y	Y/N	N	Y	N	N	Y
Inhalation	Y	Y	N	N	N	Y	Y/N	N	N	N	N	Y
External	NA	NA	NA	NA	NA	NA	NA/N	NA	NA	NA	NA	NA
SEDIMENT												
Ingestion	Y	Y	N	N	N	Y	Y/Y	N	Y	N	N	Y
Dermal Contact	Y	Y	N	N	N	Y	Y/N	N	Y	N	N	Y
Inhalation	Y	Y	N	N	N	Y	Y/N	N	N	N	N	Y
External	NA	NA	NA	NA	NA		NA/N	NA	NA	NA	NA	NA
AIR												
Inhalation	Y	Y	Y	Y	N	Y	Y/Y	Y	Y	Y	N	Y
FAUNA												
Ingestion of fish/game	N	N	N	N	N	N	N/N	N	Y	N	N	N

TABLE 6-8

SUMMARY OF EXPOSURE PATHWAYS EVALUATED FOR HUMAN HEALTH RISK ASSESSMENTS FOR FUTURE OFF-SITE LANDUSES AT EAFB

Y=pathway complete NA=pathway not applicable to site N=pathway not completed at site

EXPOSURE PATHWAYS	OU-1	OU-2	OU-3	OU-4	OU-5	OU-6	OU-7	OU-8	OU-9	OU-10	OU-11	OU-12
FUTURE OFF-SITE USES												
Residential												
GROUND WATER												
Ingestion	N	Y	N	Y		N	N	N	N	N	Y	N
Dermal Contact	N	Y	N	Y		N	N	N	N	N	Y	N
Inhalation	N	Y	N	Y		N	N	N	N	N	Y	N
SURFACE SOIL												
Ingestion	N	N	N	N		N	N	N	N	N	N	N
Dermal Contact	N	N	N	N		N	N	N	N	N	N	N
Inhalation	N	N	N	N		N	N	N	N	N	N	N
SUBSURFACE SOIL												
Ingestion	N	N	N	N		N	N	N	N	N	N	N
Dermal Contact	N	N	N	N		N	N	N	N	N	N	N
Inhalation	N	N	N	N		N	N	N	N	N	N	N
SURFACE WATER												
Ingestion	N	N	N	N		N	N	N	N	N	N	N
Dermal Contact	N	N	N	N		N	N	N	N	N	N	N
Inhalation	N	N	N	N		N	N	N	N	N	N	N
SEDIMENT												
Ingestion	N	N	N	N		N	N	N	N	N	N	N
Dermal Contact	N	N	N	N		N	N	N	N	N	N	N
Inhalation	N	N	N	N		N	N	N	N	N	N	N
AIR												
Inhalation	N	N	N	N		N	N	N	N	N	N	N
FAUNA												
Ingestion of fish/game	N	N	N	N		N	N	N	N	N	N	N

TABLE 6-9
CHEMICALS OF CONCERN AT EAFB THAT RESULTED IN THE APPLICAITON OF A REMEDIAL ACTION

(Note. Presumptive Remedy Applied at OU-3, OU05, OU-6, OU-10, and OU-12 therefore No COC listed)

COC	Operable Units											
	1	2	3	4	5	6	7	8	9	10	11	12
GROUND WATER												
benzene	X	X	-	-	-	-	-	-	-	-	X	-
ethylbenzene	-	-	-	-	-	-	-	-	-	-	X	-
toluene	-	-	-	-	-	-	-	-	-	-	-	-
xylenes	-	-	-	-	-	-	-	-	-	-	X	-
1,1,1,-Trichloroethane	X	-	-	-	-	-	-	-	-	-	-	-
1,2-DCE	X	X		X	-	-	-	-	-	-	X	-
1,2-DCA	X	-	-	X	-	-	-	-	-	-	-	-
1,1-DCE	X	-	-	X	-	-	-	-	-	-	-	-
PCE	X	-	-	-	-	-	-	-	-	-	X	-
1,2,4-Trichlorobenzene	-	-	-	X	-	-	-	-	-	-	-	-
1,4-Dichlorobenzene	-	-	-	X	-	-	-	-	-	-	-	-
TCE	X	-	-	X	-	-	-	-	-	-	X	-
vinyl chloride	X	-	-	X	-	-	-	-	-	-	-	-
benzo (a) pyrene	-	-	-	-	-	-	-	-	-	-	-	-
n-nitroso-di-n-propyalamine	-	-	-	X	-	-	-	-	-	-	-	-
bis (2-chloroethyl) ether	-	-	-	X	-	-	-	-	-	-	-	-
Aldrin	-	-	-	X	-	-	-	-	-	-	-	-
alpha-BHC	-	-	-	X	-	-	-	-	-	-	-	-
Heptachlor	-	-	-	X	-	-	-	-	-	-	-	-
Beta BHC	-	-	-	-	-	-	-	-	-	-	X	-
bis(2-ethylehexyl) phthalate	-	-	-	-	-	-	-	-			X	-
TPH	-	X	-	-	-	-	-	-	X	-	-	-
JP-4	-	X	-	-	-	-	-	-	-	-	-	-
gamma chlordane	-	-	-	-	-	-	-	-	-	-	X	-
p,p'-DDT	-	-	-	-	-	-	-	-	-	-	X	-
Cadmium	-	-	-	X	-	-	-	-	-	-	-	-
Lead	-	-	-	X	-	-	-	-	-	-	-	-
SURFACE SOIL												
benzene	X	-	-	-	-	-	-	-	-	-	-	-
1,2-DCE	X	-	-	-	-	-	-	-	-	-	-	-
PCE	X	-	-	-	-	-	-	-	-	-	-	-
TCE	X	X	-	-	-	-	-	-	-	-	-	-
JP-4	-	-	-	-	-	-	-	-	-	-	-	-
benzo(a) pyrene		X	-	-	-	-	-	-	-	-	-	-
dioxins	-	-	-	-	-	-	-	X	-	-	-	-
SUBSURFACE SOIL												
Low Level Radiological waste							X					
SEDIMENT												
benzo(a) pyrene		X	-	-	-	-	-	-	-	-	-	-

TABLE 6-10 CHEMICAL OF CONCERN AT EAFB THAT HAVE UPDATED STANDARDS

	TEV (ug/1)		NOAEL		LOAEL		RfD		RfC		Oral Slope Factor		Inhalation Slope Factor	
COC	**Past**	**Present**	**Past**	**Present**	**Past**	**Present**	**Past**	**Present**	**Past**	**Present**	**Past**	**Present**	**Past**	**Present**
benzene	5.00E+00	1.00E+00	na	na	na	na	na	3.00E-03	na	1.70E-03	2.90E-02	2.90E-02	8.30E-06	2.70E-02
l,l-DCE	7.00E+00	6.00E-02	na	na	na	9.00E+00	9.00E-03	9.00E-03	na	1.40E-01	6.00E-01	6.00E-01	na	na
TPH	na	na	na	na	na	na	na	na	na	na	na	na	na	na
JP-4	na	na	na	na	na	na	na	na	na	na	na	na	na	na
gamma chlordane	2.00E+00	1.00E-04	na	na	na	na	na	na	na	na	na	na	na	na
1,2-dichloroethane	5.00E+00	4.00E-01	na	na	na	na	na	3.00E-02	na	1.40E-03	9.10E-02	9.10E-02		9.10E-02
1,1,1-trichloroethane	2.00E+02	na	na	na	na	na	na	3.50E-02	na	2.90E-01	na	na	na	na
trichloroethylene (TCE)	5.00E+00	5.00E+00	na	na	na	na	na	6.00E-03	na	6.00E-03	1.10E-02	1. 10E-02	na	6.00E-03
2-methylnapthalene	na	na	na	na	na	na	na	na	na	na	na	na	na	na
napthalene	na	na	na	1.00E+02	na	2.00E+02	4.00E-02	2.00E-02		3.00E-03	na	na	na	na
chlordane	2.00E+00	1.00E-01	na	1.50E-01	na	7.50E-01	na	5.00E-04	na	7.00E-04	na	3.50E-01	na	3.50E-01
DDE	na	na	na	na	na	na	na	na	na	na	na	3.40E-01	na	1.50E+05
dioxins	na	na	na	na	na	na	na	na	na	na	na	1.50E-05	na	1.50E-05
PCBs	na	5.00E-04	na	na	na	na	na	na	na	na	na	2.00E+00	na	2.00E+00
arsenic	na	5.00E+01	na	na	na	na	na	3.00E-04	na	na	1.75E+00	1.50E+00	1.51E+00	150E+00
aluminum	na	na	na	na	na	na	na	1.00E+00	na	1.40E-03	na	na	na	na
berylium	1.00E+00	4.00E+00	na	na	na	na	5.00E-03	2.00E-03	na	na	4.30E+00	na	8.40E+00	na
chromium	1.00E+02	1.00E+02	na	2.50E+01	na	na	1.00E+00	3.00E-03	na	8.00E-06	na	na	na	2.90E-02
cobalt	na	na	na	na	na	na	na	6.00E-02	na	na	na	na	na	na
lead	5.00E+00	[1]	na	na	na	na	na	na	na	na	na	na	na	na
manganese	na	na	na	1.40E-01	na	na	5.00E-05	1.40E-04	5.00E-05	5.00E-05	na	na	na	na
thallium	2.00E+00	2.00E+00	na	na	na	na	na	na	na	na	na	na	na	na
toluene	1.00E+00	1.00E+00	na	3.12E+02	na	6.25E+02	1.10E-01	2.00E-01	na	4.00E-01	na	na	na	na

COC-Chemical of Concern
TEV- Toxicity value as MCl, or other state or federal limit
NOAEL- No Observed Adverse Effects Level
LOAEL-Lowest Observed Effects Level
RfDs- Reference dose for exposure by ingestion
RfC's-Reference concentration for exposure by inhalation
na- No published value found in literature
1-Lead MCL is treatment at the tap, MCLG(goal) is zero

Sources: EPA Integrated Risk Information System
National Center for Environmental Assessment
EPA Drinking Water Regulations and Health Advisories
EPA Region III Risk - Based Concentration Table
EPA Region 9 Preliminary Remediation Goals (PRGs) Table

7.0 ASSESSMENT

7.1 REMEDY OPERATION

7.1.1 HASP and Contingency Plan

All work conducted at the site is completed in compliance with the Base Wide Health and Safety Plan (HASP) unless an addendum to the HASP is submitted for a particular activity or operable unit. All workers are required to attend a Health and Safety briefing and site walk over prior to commencing work at any operable unit.

A Contingency Plan is also in place for all OU's. the Contingency Plan consists of an ongoing process within the Long Term Monitoring/Long term Operations (LTM/LTO) program that will identify any failure of the selected remedy or remedies; establish a budget for necessary corrective action; obtain funding through the Air Force=s project programming system: and implement the corrective action. For Operable Units that included a landfill cap as a part of the final selected remedy, quarterly visual inspections of the landfill caps are conducted and repairs are performed as needed to maintain the integrity of the caps to assure compliance with the RODs.

7.1.2 Institutional Controls and Other Measures

Institutional controls and others measures applied at EAFB included a standing order by the Base commander restricting property use at specific OUs, installation of fencing and posting new signs identifying areas as restricted to control access to the sites and the development of appropriate deed restriction language that could be placed on properties should they be sold or transferred from the Air Force in the future. The deed restrictions have not been filed as no specific properties have been sold or transferred, nor is the Base contemplating a full Base closure, which would require restrictions being registered on County property records. Base maps depicting environmentally impacted areas are periodically updated. Contaminated ground water plumes are monitored quarterly or semi-annually and data is presented in LTM reports.

The institutional controls have been effective for controlling access to the OUs, with one noted exception. At OU-8 out of date or unstable ordnance was destroyed (exploded) on one occasion. Prior to detonation of the ordnance the site was graded and a shallow burn/blast pit was constructed. This excavation resulted in breaching of the soil coyer placed on this area as part of the selected remedial action for the OU. This action resulted in a temporary breach of the soil coyer and the violation of the institutional controls established for the protection of human health and the environment. The Base made immediate evaluations of the action and has repaired the coyer. This effort included, review of operation directives, providing for additional staff/personal training, completion of sampling and analysis of surface soil samples to determine if COCs had been released, installation of new signage, development and distribution of a new Base map showing environmentally restricted areas, and re-issuance of the Base Commander Continuing Order Policy.

The institutional controls have been effective for controlling access to the flightline refueling area and JP-4 area.

7.1.3 Remedial Action Performance

The following is a summary of remedial action performance and history at all operable units including system performance and progress towards cleanup leyels. Recommendations for changes in the monitoring program at each Operable Unit are contained in Chapter 9.

OU-1

OU-I contained the Former Fire Protection training Area (FPTA) and is located on the southwest portion of EAFB northwest of the alert apron and east of Kenny Road. OU-1 covers approximately ten acres and consisted of a centrally located, unlined, bermed burn pit, a steel aircraft mockup and surrounding land. The burn pit was the source area of contamination.

Soils at OU-1 contained JP-4 (jet fuel); benzene, toluene, ethylbenzene, xylenes (BTEX); and, chlorinated volatile organic compounds (VOCs). JP-4 concentrations were much higher than other compounds. Ground water at OU-1 contained chlorinated VOCs, BTEX and JP-4. Light non-aqueous phase liquids (LNAPLS) were present in the northern and southern end of the FPTA. Dense non-aqueous phase liquids (DNAPLS) were not present at OU-1. Ground-water contamination in this area did not extend beyond the Base boundary.

The remedial system in the OU-1 area consists of a combined soil vapor/ground water extraction system. The system is designed to treat highly contaminated soils and ground water as well as to contain the ground water contaminant plume of site. Institutional controls at this site consist of a fenced perimeter with a locked gate and appropriate signs to restrict access to the OU. It appears from the LTM that the OU-1 system is functioning as designed; however it is unlikely that the system will reach MCLs in the near future. It was estimated in the original design analysis that it would take 25 years to remediate soil and ground water at this site.

OU-2

The OU-2 study area consisted of former Landfill No. 1 (21.5 acres), former Landfill No. 6 (0.5 acres), a drainage channel in the western portion of Landfill No. I and a drainage channel near Landfill No. 6 which included Pond 002.

Within OU-2, soils contained chlorinated VOCs, BTEX, and polynuclear aromatic hydrocarbons (PAHs). All but one of the reported concentrations in soil was below the 10^{-6} risk based level calculated for excess carcinogenic risks. Monitor wells installed in the interior of Landfill No. 1 indicated the presence of TCE and DCE in five samples at maximum concentrations of 14 ug/L and 19 ug/L, respectively.

The remedy the OU-2 area consists of a landfill cap to prevent movement of contaminants, creation of a drainage ditch and a LTM program. It appears that the remedy at this site is functioning as designed. Institutional controls at this site consist of a fenced perimeter with a locked gate and appropriate signs to restrict access to the OU. Two removal actions took place in the OU-2 area. Mustard agent test kits and low-level radioactive waste were excavated from this area and disposed at an off- base location.

OU-3

OU-3 is located in the northeast portion of EAFB and consisted of former Landfill No. 2 (one acre), four trenches to the north, and two disturbed areas in the southeast and southwest corners of the OU.

Soil and soil vapor samples from OU-3 indicated the presence of VOCs. BTEX, methane (soil vapor only) and semi-volatile organic compounds (SVOCs) (soil only). The calculated carcinogenic risk level for surface soil was 1×10^{-6}, due to the presence of SVOCs. This was within the acceptable range.

Ground-water samples indicated the presence of chlorinated VOCs and petroleum constituents.The calculated carcinogenic and non-carcinogenic risks for ground water exceeded the acceptable carcinogenic and non-carcinogenic risk ranges.

The selected remedy in the OU-3 area consists of a landfill coyer and a LTM plan. Institutional controls at this site consist of a fenced perimeter with a locked gate and appropriate signs to restrict access to the OU.

OU-4

OU-4, which includes Landfill No. 3, is a 40-acre site located south of the aircraft control tower in the southwestern portion of the Base.

Soil at OU-4 contained elevated VOCs, SVOCs, and pesticides within the EAFB boundary. Ground water contained chlorinated VOCs, SVOCs, and pesticides. Contaminated ground water within this OU moved from the landfill, located within the original Base boundaries, to an adjacent area within the OU, which is now owned by the Air Force.

The remedial system in the OU-4 area consists of a land fill cap and ground water extraction system. The landfill cover is designed to prevent infiltration through buried waste while the ground water extraction system is designed to contain the plume. Institutional controls at this site consist of a fenced perimeter with a locked gate and appropriate signs to restrict access to the OU. It appears at this time from the long term monitoring program that the OU-4 remedial system is functioning as designed and the effort at plume containment are effective. It was estimated in the original design analysis that it would take 15 years to remediate the off-Base portion of the plume. The on-Base portion of the plume will take significantly longer as the source of contamination remains in place.

OU-5

OU-5 included the area surrounding and including Landfill No. 4, a ten-acre site near the northern perimeter of EAFB.

Polynuclear aromatic hydrocarbons (PAHs) at estimated values below the sample quantitation limit (48 ug/kg to 250 ug/kg) and JP-4 jet fuel, in one surface soil sample (SB930502) at 190 mg/kg, were reported in soil samples collected from OU-5. Jet fuel was also reported at a concentration of 100 ug/L in one ground-water sample collected during the investigation.

The remedy in OU-5 consists of a landfill cap and a LTM program. Institutional controls at this site consist of a fenced perimeter with a locked gate and appropriate signs to restrict access to the OU. The remedy is not functioning as designed due to the occurrence of a slide in the landfill coyer area. The Base, COE, contractors, and South Dakota School of Mines soil experts investigated the area of the slide.

Initial repairs were completed to the slide in August of 2000. The area will be monitored and additional investigations to develop more information on the cause and possible more permanent control measures for the slide area will be developed. Ground water has been impacted as a result of this situation. Low concentrations of VOCs (<1 ug/l) were detected during the July 1999 sampling event in all wells including the upgradient well.

OU-6

OU-6 consisted of Landfill No. 5, which is approximately seven acres in size and is located near the southern end of EAFB.

Polvnuclear aromatic hydrocarbons and pesticides were reported in soil samples collected from OU-6. Levels of VOCs and metals contaminants observed in the ground water at the site were below Maximum Contaminant Levels (MCLs) or considered to be representative of background levels.

The remedy in the OU-6 area consists of a landfill cap and a LTM program. Institutional controls at this site consist of a fenced perimeter with a locked gate and appropriate signs to restrict access to the OU. It appears that the remedy is functioning as designed and that ground water has not been impacted by contamination from waste in the landfill.

OU-7

OU-7 included the Low-level Radioactive Waste Burial site located in the Weapons Storage Area (WSA) at the northern end of the Base. The WSA covers approximately 65 acres and is currently active. The site contained five underground tanks, which were designed to hold equipment wash down water. The record search for the OU-7 investigation found no evidence that these tanks were ever used for the purpose of holding wash down water containing radioactive materials. the tanks were sampled in 1993 and the reported date indicated that the tanks were clean and verified the historical records indicating they had not been used. The tanks were emptied of water in 1993 and, in order to sample the soils surrounding the tanks, the tanks were removed and disposed.

Scattered detections of VOCs were reported in surface soil samples at OU-7; concentrations were below 10^{-6} risk based concentrations for Human Health Risks. Radionuclides were determined to be present within the normal background range due to natural variations in soil types and geological characteristics.

The remedy in the OU-7 area consists of monitored natural attenuation. Institutional controls at this site consist of a fenced perimeter with a locked gate and appropriate signs to restrict access to the OU. It appears that the remedy is not functioning as designed as the plume margin has been expanding. The VOC contamination is rather low level and the plume margin is a significant distance from the base boundary thus no action is warranted at this time. A low-level radioactive waste (LLRW) removal action also was performed in this OU. The LLRW was disposed of at an offsite location.

OU-8

OU-8 consisted of two distinct areas of investigation, the Explosive Ordnance Disposal (EOD) Area and the Debris Burial Area. The EOD site study area included a Pramitol spill area, burning pit area, burn furnace area, and a detonation site.

Volatile organic chemicals and SVOCs were detected in ground water during the remedial investigation (RI). The reported concentrations of these contaminants were less than or equal to 2 ug/1. No MCLs or EPA risk-based concentrations exist for the reported contaminants. Natural occurring levels of antimony and selenium were reported above the MCL in one or more ground-water samples. Toluene was the only VOC detected in soil samples collected in the EOD area during the RI. PAHs and phthalates were also detected in the soil. PAHs typically result from incomplete combustion of organic materials. Dioxins in the soil correlated with combustion activities in the EOD area. Dioxin concentrations were low, well below action levels of 1,000 picograms/KG (ug) for residential soils. the risk assessment for OU-8 indicated that there are no unacceptable non-carcinogenic or carcinogenic risks at the OU under current land use conditions, resulting from activities conducted at OU-8.

The remedy in the OU-8 area consists of a soil cover and a LTM plan. Institutional controls at this site consist of a fenced perimeter with a locked gate and appropriate signs to restrict access to the OU. The remedy appears to be functioning as designed. However, in the fall of 1999, Air Force personnel inadvertently disturbed the landfill cap. The coyer was restored immediately when the disturbance was discovered. No ground water impacts have occurred.

OU-9

OU-9 had a no action ROD

OU-10

OU-10 had a no action ROD

OU-11

This is the Basewide ground water Operable Unit. Remedial investigation/feasibility study (RI/FS) and remedial actions (Ras) were developed for those areas of the Base that were not part of the other specific Operable Units. to facilitate project planning, OU- I 1 was divided into two parts. Area 1, and Area 2. Areas of ground water contamination at OU-9 and OU-10 were addressed within OU-11 as Area 1. Contaminated ground water in Area 1 lays entirely on-Base. Volatile organic compounds. SVOCs, and petroleum hydrocarbons were detected in ground water samples from the South Docks Area. Trichloroethene (TCE) was the most frequently reported compound in the ground water samples along with its breakdown products.

Area 2 includes the areas where ground water contamination has moved off-Base along the eastern boundary. Off-site contamination associated with these areas has also been referred to as Area Of Concern 24 (AOC-24). The contaminant of concern associated with Area 2 is TCE and its associated breakdown products.

The ground water at OU-11 also was impacted by petroleum releases associated with refueling of airplanes at the flightline refueling area (FRA). No commingling of hazardous substances occurred at this site, therefore; remediation activities associated with the FRA are addressed under the SDDENR petroleum release program.

The remedy in the OU-11 area consists of eight ground water extraction systems that are designed to contain a low level chlorinated hydrocarbon. Institutional controls at this site include a fenced perimeter with a locked gate and appropriate signs to restrict access. It appears that the systems are functioning as

designed although due to the expanse of the plumes it is unlikely that contaminant levels will reach MCL's in the near future.

An off base water line conveying potable water to land owners impacted by the off site portion of the plume in the AOC 24 area has been installed to mitigate any potential risk to the public. An additional water line was constructed to serve property located south of the Base near OU-4. This water line was installed to limit the pumping of the ground water in this area as the TCE plume from the OU had moved south of the Base boundary and had been detected in private domestic wells.

OU-12

OU-12 was located in the southern half of EAFB, immediately north of the Alert Apron and southwest of the runway. OU-12 was designated as Hardfill No. 1. which was approximately 14 acres in size. This landfill received building and road demolition rubble from maintenance and repair activities on the Base. Historical records indicated that the landfill was used for disposal of this demolition rubble only, and did not receive hazardous wastes. The investigation showed the presence of VOCs. SVOCs, jet fuel and pesticides, but through site characterization it was found that these contaminants were related to flightline runoff rather than landfill disposal practices. Levels of contaminants observed in the ground water at the site were below-Maximum Contaminant Levels. A single upgradient well reported TCE in a ground water sample at a concentration of 7 ug/L. The risk assessment for OU-12 indicated that the total carcinogenic site risk is within the acceptable risk range for the residential scenario and is less than 1×10^{-6} for the industrial scenario.

The remedy in the OU-12 area consists of a landfill cover and a LTM plan. The institutional controls at this site include a perimeter fence with locked gates and appropriate signs to restrict access to the OU. The remedy appears to be functioning as designed however TCE concentrations in ground water continue to exceed MCLs although the concentrations are low.

7.1.4 Operation and Maintenance

Operation and maintenance activities are conducted on a daily basis. Operation and maintenance consists trouble shooting any problems that occur at any of the active remediation sites as well as scheduled preventative maintenance. Operation and maintenance activities are outlined in Chapter 4.

7.1.5 Operation and Maintenance Costs

Operations and maintenance (O&M) costs include costs of operating the remediation systems, and costs for long-term monitoring of ground water at the operable units.

O&M costs for the operation and monitoring of the remediation systems at OU-1. OU-4, JP-4, OU-11, and the Flightline Refueling Area were $1,014,000 for the 12-month period ending July 31, 2000. This includes labor, materials, equipment, and maintenance costs for the remediation systems and labor, analytical costs. and reporting costs for the monitoring program at these OUs.

Long-Term monitoring costs for OU-3, OU-5, OU-6. OU-7, OU-8, and OU-12 were approximately $150,000 for the period ending July 31, 2000. These costs are principally the costs for periodic sampling and analysis of monitor wells at these sites, as well as related evaluation and reporting of the monitor well data.

7.1.6 Remedial Action Optimization

The remedial systems are continually monitored and examined for ways to optimize the system and reduce costs. This includes preventative maintenance, shutting down systems where remediation has been achieved, optimizing treatment systems (i.e., taking carbon filters off line at Pump House No. 1) and continually changing monitoring and sampling plans to account for changes in plumes or system operations. Remedial actions are monitored on an ongoing basis to evaluate system effectiveness and to find ways to optimize systems to remove the maximum contaminant mass.

7.1.7 Indicators of Potential Failures

There have been no chronic recurrent equipment breakdowns that could potentially impact the selected remedies. When equipment breakdowns occur the onsite O&M staff have the skill and resources to deal with the problem in a timely manner.

Two issues have recurred on several occasions that affect the effectiveness of the ground water remediation system. The first issue is biofouling of ground water extraction wells. Biofouling drastically decreases flow from the extraction wells and as a result makes the remedial system less effective. Extraction-well pumping rates are constantly monitored to try to detect fouling and when fouling occurs extraction wells are redeveloped.

The second issue is high selenium in the effluent from the CTF. Selenium is a naturally occurring substance. Occasionally levels of selenium will exceed permissible standards for discharge to a surface water body. When this occurs several extraction wells known to high levels of selenium are shut off. This generally occurs during periods of low flow.

It is not anticipated that either of the above mentioned issues could lead to failure of the remedial action or suggest that the RA is not protective of human health and the environment.

The cover at landfill 5 has had a series of cracks or sinks develop. The southeast face of the OU slumped significantly in 1999. The Air Force along with engineering and soil experts from contractor firms and the South Dakota School of Mines investigated the site. This investigation recommended repairs to the slide area and further monitoring, for additional movement. The repair work was completed in August of 2000. The area will be monitored to determine what further actions may be required.

7.2 VALIDITY OF ASSUMPTIONS

7.2.1 Changes in TBC Criteria

The ARARs and TBC Criteria used to develop the remedial action selection process at EAFB were appropriate at the time of FS and ROD development and no changes in the chemical, action of location specific criteria have resulted in the need to reevaluate these ARARs or TBC criteria. The criteria selected were and continue to be protective of human health and the environment.

7.2.2 Changes in Exposure Pathways

The exposure pathways evaluated as part of the human health risk assessment were appropriate for the conditions existing at the time of the completion of the RI, FS and RODS. Current conditions and anticipated future conditions on-Base and on off-Base properties are represented appropriately by these pathways and no revisions are needed. The completed ground water pathway at the BG-04/BG-05 area off-Base to the east adds a completed pathway that was not specifically addressed in the human health risk assessment for OU-11. However, the remedial actions applied to this site have taken into consideration of a completed pathway and the application of MCLs as cleanup goals will be protective of human health and the environment.

7.2.3 Changes in Toxicity and Contaminant Characteristics

Table 6-10 summarizes changes in toxicity values applicable to specific COCs identified at EAFB. The changes in the toxicity values of the few organic COCs identified in Table 6-10 are not expected to affect the overall remedial actions at EAFB. The COCs reported at EAFB are expected to be removed and/or contained by the remedies selected for EAFB. In those situations where one of the toxicity values decreased the calculated dose or exposure concentration to receptors. and therefore risk, would increase. Weather these changes are significant is chemical and exposure pathway specific. The assumptions made in the risk assessments were to evaluate the risk using both average and reasonable maximum exposures (RMEs). This resulted in a conservative risk approach for the site and marginally acceptable or unacceptable risks were considered when developing remedial actions. The design of the remedial systems at EAFB was completed based on the cleanup goals listed in the RODs. These clean up goals took into consideration the results of the human health and ecological risk assessments and MCLs and other State standards. For ground water remediation the MCLs were the primary consideration during design. therefore unless the MCLs change the changes in the toxicity values used to estimate risk at the operable units will be reviewed while evaluating protectiveness of the remedial decision but would not specifically drive the selection or re-design of a remedial action.

7.2.4 Changes in Risk Assessment Method

Human health risk assessments and the risk scenarios applied at EAFB were appropriate for the identified completed pathways and current and anticipated future land use. No revisions or changes in the assumptions appear appropriate based on current information. The dermal risk calculations completed in the RI reports were based on 1989 EPA Guidance Manuals. Utilization of the current EPA Dermal Risk Assessment Guidance for Superfund would likely result in lower calculated risks.

The ecological risk assessment completed as part of the RI process at EAFB utilized a three-tiered assessment approach. The Tier I level included evaluations, observation and assessment of habitat values at the OUs. Wetland and terrestrial plant communities were evaluated in the field and augmented with anecdotal and systematic wildlife observations. The Tier I data was used to evaluate the sites in more detail under Tier II where either species of concern were identified or significant habitat that could attract wildlife was present even though Tier I field data did not indicate the presence of the wildlife during the study. The Tier II investigations focused on the evaluation of benthic invertebrates, fish. and terrestrial invertebrates. Field observations of birds and other terrestrial fauna were completed. If initial screening of data under the first two Tiers indicated, either, degraded benthic, fish or soil fauna communities or elevated concentrations of COCs in sediment. surface water of soils then the site was carried to the Tier III level of investigation. The Tier III evaluation involved detailed quantitative ecological risk assessments. This approach was consistent with the USEPA guidance for the selection of assessment and

measurement endpoints in ecological risk assessments. None of the individual OUs were carried over to a Tier III investigation. however a Basewide evaluation was completed.

The Basewide Ecological Risk Assessment for EAFB was structured according to U.S. EPA guidance, and consists of four related components (EPA 1992): problem formulation. exposure assessment, ecological effects assessment. and risk characterization. The relationship of these components is illustrated in Figure 7-l. This model provided a logical sequence from Problem Formulation (identification of Chemicals of Concern [COCs], Receptors of Concern [ROCS], exposure pathways [in the Conceptual Site Model (CSM)], and measurement and assessment endpoints), to Analysis characterization of exposure and toxicological effects), to Risk Characterization (the integration of exposure and ecological [toxicological] effects assessments).

The structure of the Basewide ecological risk assessment evolved throughout the remedial investigation process. Some of the elements of Problem Formulation. i.e.. identification of stressors and ecological components, were an outgrowth of the preliminary risk screens done at each individual OU. This information was reviewed and discussed with the EPA Region VIII Ecological Technical Assistance Group (ETAG) Ultimately, the Problem Formulation phase was formalized as shown in Figure 7-l, and the components of Analysis and Risk Characterization were added to the framework to support the Basewide ecological risk assessment.

In 1998 the USEPA issued updated ecological risk assessment methods and standard guidance that has changed since this evaluation was done at EAFB. The tiered approach used in the ecological risk assessments completed for EAFB is still one of the recommended approaches. The completed risk assessment did not identify excessive risk exposures for the Species of Concern nor were any habitats identified as needing remedial actions. The assumptions made during the ecological risk assessment were appropriate and protective of the ecological community at and adjacent to EAFB.

8.0 DEFICIENCIES AND MODIFICATIONS

Information on past deficiencies and applied modifications was presented in Table 4-5 and was discussed in section 7.1.3. The following summarizes the deficiencies/problems identified during this five-year review.

OU-1 Continued occasional selenium discharge limit violation at the central treatment facility.

OU-2 Increased concentrations of TCE in some boundary monitor wells. Need to evaluate if extraction system is fully capturing the plume.

OU-3 No identified issues.

OU-4 Increased concentrations of TCE in some boundary monitor wells. Need to evaluate if extraction system is fully capturing the plume.

OU-5 Slope failure along the southeast and north face of the landfill has opened cover and resulted in exposure of some old fill material. Need to continue evaluation for correction of the problem.

OU-6 No issues identified.

OU-7 Increased concentration of TCE in boundary monitor wells. Need to continue monitoring.

OU-8 No issues identified.

OU-9 No issues identified.

OU-10 No issues identified.

OU-11 No issues identified.

OU-12 No issues identified.

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

A Remedial Project Manager (RPM) group is in place to oversee the Installation Restoration Program at Ellsworth Air Force Base. The group is comprised of personnel/managers from the Air Force, Corps of Engineers Omaha District, South Dakota Department of Environment and Natural Resources, EPA Region 8, and contractors. The purpose of this group is to monitor the remedies and remedial actions selected for the 12 Operable units at Ellsworth Air Force Base. As deficiencies or opportunities for optimization are identified. they are addressed by the RPM group. A list of deficiencies and their resolutions was presented in Chapter 7.

The group is also responsible for programming and obtaining funding for additional work at the base that will ensure the remedies will continue to be protective of human health and the environment or continue or to progress towards to being protective of human health and the environment (i.e. O&M of RA systems and LTM monitoring).

Table 9-l contains recommended LTM revisions. These recommendations are based on evaluation of LTM data, recent LTM data is presented in Appendix A.

Based on the results of agency review comments and the evaluations completed as part of this first five-year review at EAFB the following additional recommendations are suggested for evaluation and consideration for completion prior to the next five-year review:

1. Conduct a detailed evaluation of the geophysical conditions at OU-5 that have or may have contributed to the soil slide conditions observed at this OU. This evaluation should recommend a solution to the problem.

2. Review the available dioxin data from OU-8 and compare the data to the new information published by the US EPA on dioxins and PCBs. Review the risk implications of these changes if the data indicates that the dioxin and PCBs concentrations are different than action levels.

3. Develop a data summary table containing the analytical data from the RI and the LTM programs. Compare the data set to the risk based screening levels and preliminary remediation goals levels published by EPA Regions 9 and 3, respectively. This data file should be updated with new LTM data as it becomes available.

4. Complete an evaluation of the ground water elevations and chemical contaminant concentrations of the plumes at OU-l, OU-2 and OU-4. The evaluation should be focused on determining if there is an inter-relationship between the plumes and ground water flow patterns and evaluate if the remedial actions installed are providing containment of these plumes.

5. Develop a decision tree/process which provides an approach to the close out and finalization of the remedial action process for operable units as they reach applicable cleanup levels. This could include recommendations on the duration of operation and monitoring after the systems meet remediation goals, and/or how to document asymptotic conditions. Development of a list of documents and or reports necessary to close out a site.

6. Develop a series of maps that show the changes in contaminant plume size and concentration levels over time for each OU with an active remediation system.

7. Develop a statistical evaluation of the removal rates and effectiveness of the each remedial system. Evaluations should provide estimates of percent of original contamination removed, estimated remaining contamination mass, and estimates of remaining time needed to remediate the plume.

8. The Air Force will address the issues raised during the community interview process.

9. Evaluate revisions to the Long Term Monitoring Plan.

10.0 PROTECTIVENESS STATEMENTS

10.1 OU-1

The remedy at this site is expected to be protective of human health and the environment and immediate threats have been addressed. The OU-1 remedy consists of SVE and ground water extraction components which are designed to remediate hotspot contamination in the immediate vicinity of the old fire training pit area and to contain the plume onsite. IDW soils from the OU-1 area as well as several other operable units were treated with microbes to regulatory levels and thin spread on site. A fence has also been installed to restrict access to the operable unit. A long-term ground water monitoring program is also in place at this operable unit.

Information gathered to date at this site indicates a significant amount of contaminant mass has been removed from the site and the ground water contaminant plume has been contained.

10.2 OU-2

The remedy at this site is protective of human health and the environment. A landfill cap was installed at this site preventing the infiltration of rainwater as well as direct contact with contaminated soils and a drainage flume was also installed in this area to reroute drainage around the landfill. A fence has also been installed to restrict access to the operable unit. Two removal actions also occurred at the site. Mustard gas and LLRW were excavated from this area and disposed of off site.

The landfill cap is inspected for integrity on a quarterly basis and a long term ground water monitoring program is also in place at this operable unit. Information gathered to date at this site indicates that the landfill cap and drainage flume appears to be functioning as designed.

10.3 OU-3

The remedy at this site is protective of human health and the environment. A landfill cap was installed at this site preventing the infiltration of rainwater as well as direct contact with contaminated soils. A fence has also been installed to restrict access to the operable unit.

The landfill cap is inspected for integrity on a quarterly basis. A long term ground water monitoring program is also in place at this operable unit. Information gathered to date at this site indicates that the landfill cap appears to be functioning as designed although the landfill cap integrity may be threatened by the subsidence occurring at OU-5.

10.4 OU-4

The remedy at this site is expected to be protective of human health and the environment and immediate threats have been addressed. A landfill cap was installed at this site preventing the infiltration of rainwater as well as direct contact with contaminated soils. An off base property that was impacted by the chlorinated hydrocarbon plume originating under the landfill was acquired by the Air Force. A series of ground water extraction wells were installed on and off base to address the offsite movement of the chlorinated hydrocarbon plume. A fence has also been installed to restrict access to the operable unit.

The landfill cap is inspected for integrity on a quarterly basis. A long term ground water monitoring program is also in place at this operable unit. Information gathered to date at this site indicates that the landfill cap appears to be functioning as designed and the ground water plume appears to be contained.

10.5 OU-5

The remedy at this site is not protective of human health and the environment. A landfill cap was installed at this site preventing the infiltration of rainwater as well as direct contact with contaminated soils. Institutional controls are in currently in place that prevent access to this operable unit and the landfill cap is inspected for integrity on a semi annual basis. The landfill cap in this area has subsided over time and has been repaired several times. Long term solutions for the subsidence problems are currently being examined. A fence has also been installed to restrict access to the operable unit.

The landfill cap is inspected for integrity on a quarterly basis. A long term ground water monitoring program is also in place at this operable unit. Information gathered to date at this site indicates that the landfill cap appears to be functioning as designed.

10.6 OU-6

The remedy at this site is protective of human health and the environment. A landfill cap was installed at this site preventing the infiltration of rainwater as well as direct contact with contaminated soils. A fence has also been installed to restrict access to the operable unit.

The landfill cap is inspected for integrity on a quarterly basis. A long term ground water monitoring program is also in place at this operable unit. Information gathered to date at this site indicates that the landfill cap appears to be functioning as designed.

10.7 OU-7

The remedy at this site is protective of human health and the environment. The remedy for the OU-7 area is monitored natural attenuation. Quarterly monitoring is conducted at this site to assess natural attenuation and plume movement. Institutional controls, included restricted access and fencing, prevent access to this is restricted.

Information gathered to date at this site indicates that the plume may be expanding but is still a significant distance from the base boundary.

10.8 OU-8

The remedy at this site is protective of human health and the environment. A soil cover was installed at this site preventing direct contact with dioxin contaminated soils. A fence has also been installed to restrict access to the operable unit.

The soil cover is inspected for integrity on a quarterly basis. A long term ground water monitoring program is also in place at this operable unit. US Air Force personnel disturbed the soil cover in the fall of 1999 while disposing of some unexploded ordinance. The soil cover was repaired in the fall of 1999. Information gathered to date at this site indicates that the soil cover appears to be functioning as designed.

10.9 OU-9

A no action ROD was prepared for this operable unit. Some of the ground water in this area is being treated and remediated under the OU-11 base wide ground water ROD.

10.10 OU-10

A no action ROD was prepared for this operable unit.

10.11 OU-11

The remedy at this site is expected to be protective of human health and the environment and immediate threats have been addressed. The remedy at OU-11 consists of eight remedial systems. Five of the remedial systems are connected to a common treatment plant located at Pumphouse No. 1. The remedial systems are located in the South Docks Main area, 30 Row and 50 Row, the Building 102 area and the Pride Hangar area. The remaining three systems are located in the BG04 west, the BG04 base boundary and the BG05 base boundary areas.

The remedial systems in the OU-11 area appear to be functioning as designed containing the plumes and reducing the mass within the plumes. Institutional controls are in place that prevents use of impacted water in the off base portion of the plume affected parties have been supplied with an alternate source of water.

10.12 OU-12

The remedy at this site is protective of human health and the environment. A landfill cap was installed at this site preventing the infiltration of rainwater as well as direct contact with contaminated soils. A fence has also been installed to restrict access to the operable unit.

The landfill cap is inspected for integrity on a quarterly basis. A long-term ground water monitoring program is also in place at this operable unit. Information gathered to date at this site indicates that the landfill cap appears to be functioning as designed.

11.0 NEXT REVIEW

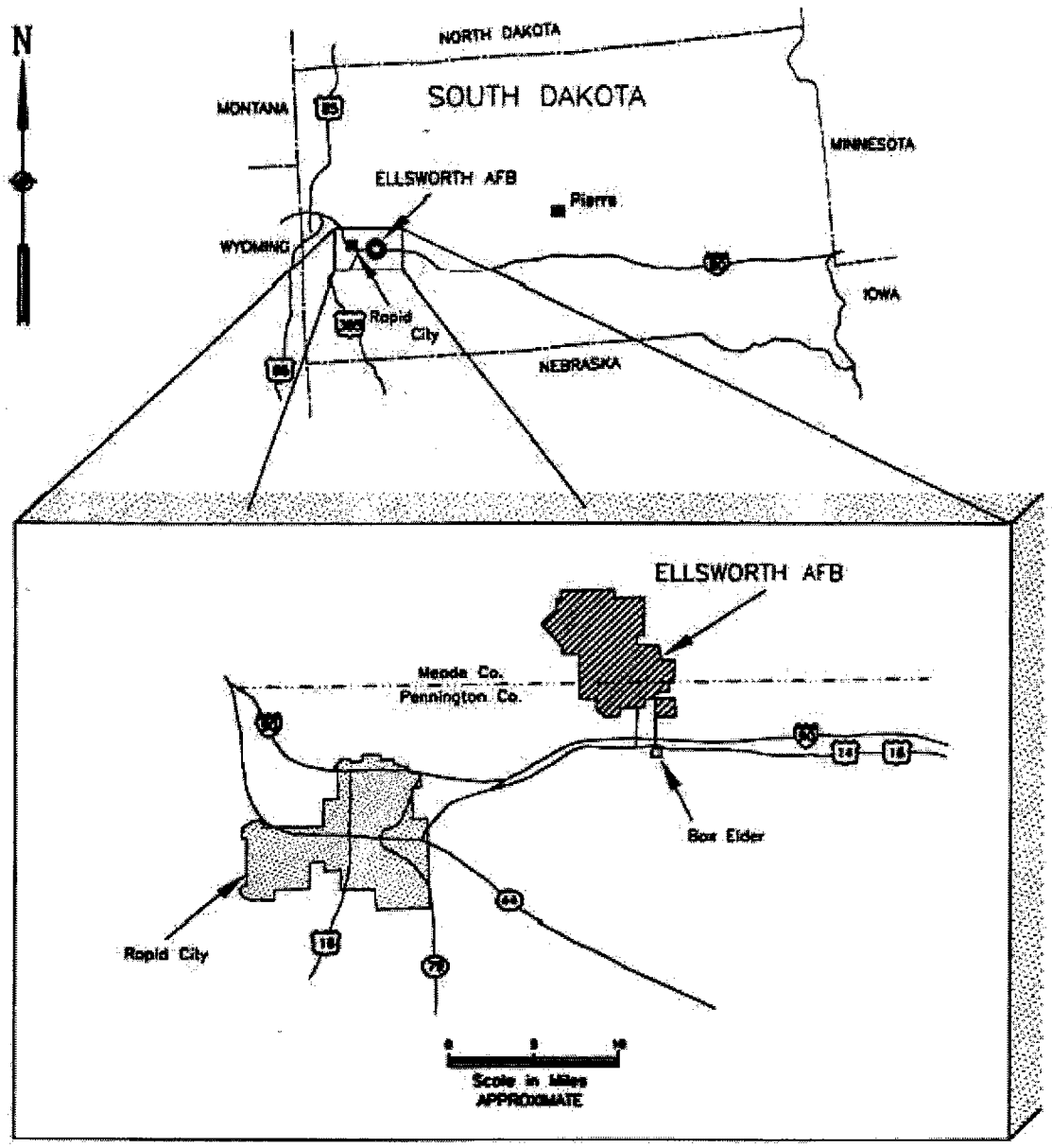
The next five year review should be:

Initiated By: 1 April 2005

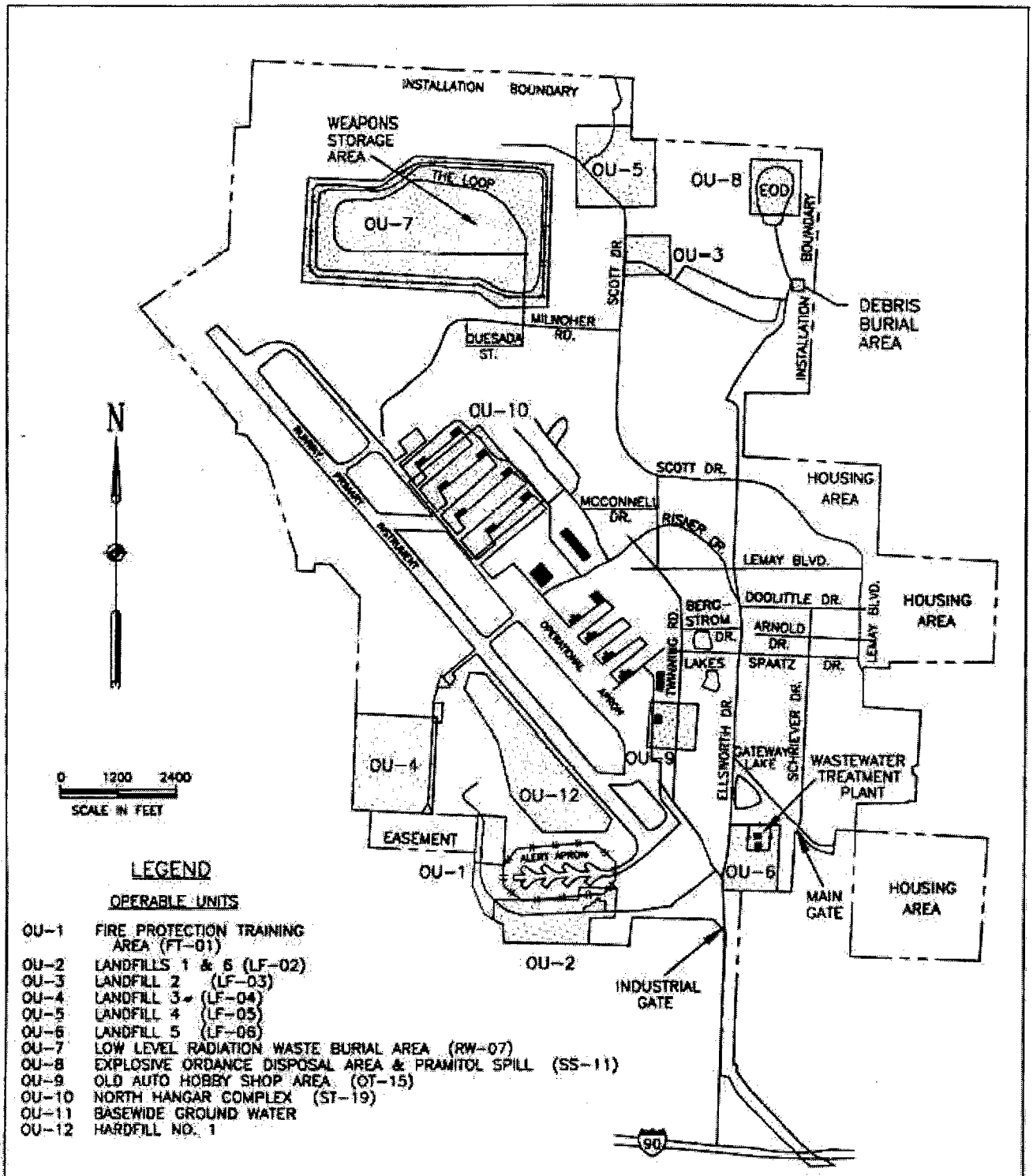
Completed By:30 September 2005.

12.0 MISCELLANEOUS COMMENTS

FIGURES



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA			AREA LOCATION MAP			
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE:
		MRG		AS SHOWN	DEC 95	60378.93	3-1



LEGEND

OPERABLE UNITS

OU-1	FIRE PROTECTION TRAINING AREA (FT-01)
OU-2	LANDFILLS 1 & 6 (LF-02)
OU-3	LANDFILL 2 (LF-03)
OU-4	LANDFILL 3 (LF-04)
OU-5	LANDFILL 4 (LF-05)
OU-6	LANDFILL 5 (LF-06)
OU-7	LOW LEVEL RADIATION WASTE BURIAL AREA (RW-07)
OU-8	EXPLOSIVE ORDANCE DISPOSAL AREA & PRAMITOL SPILL (SS-11)
OU-9	OLD AUTO HOBBY SHOP AREA (OT-15)
OU-10	NORTH HANGAR COMPLEX (ST-19)
OU-11	BASEWIDE GROUND WATER
OU-12	HARDFILL NO. 1

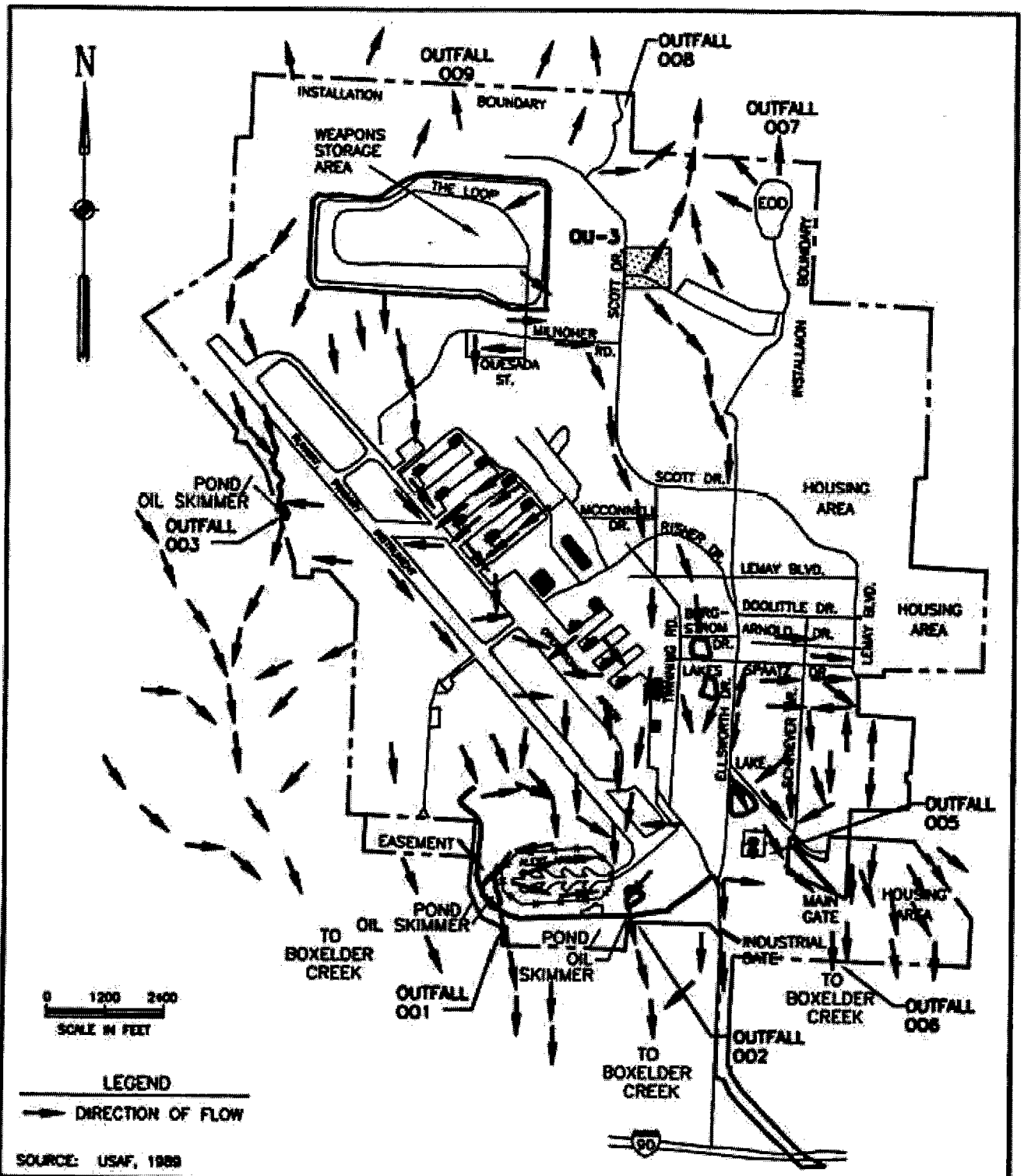
ELLSWORTH AIR FORCE BASE

ELLSWORTH AFB
RAPID CITY, SOUTH DAKOTA

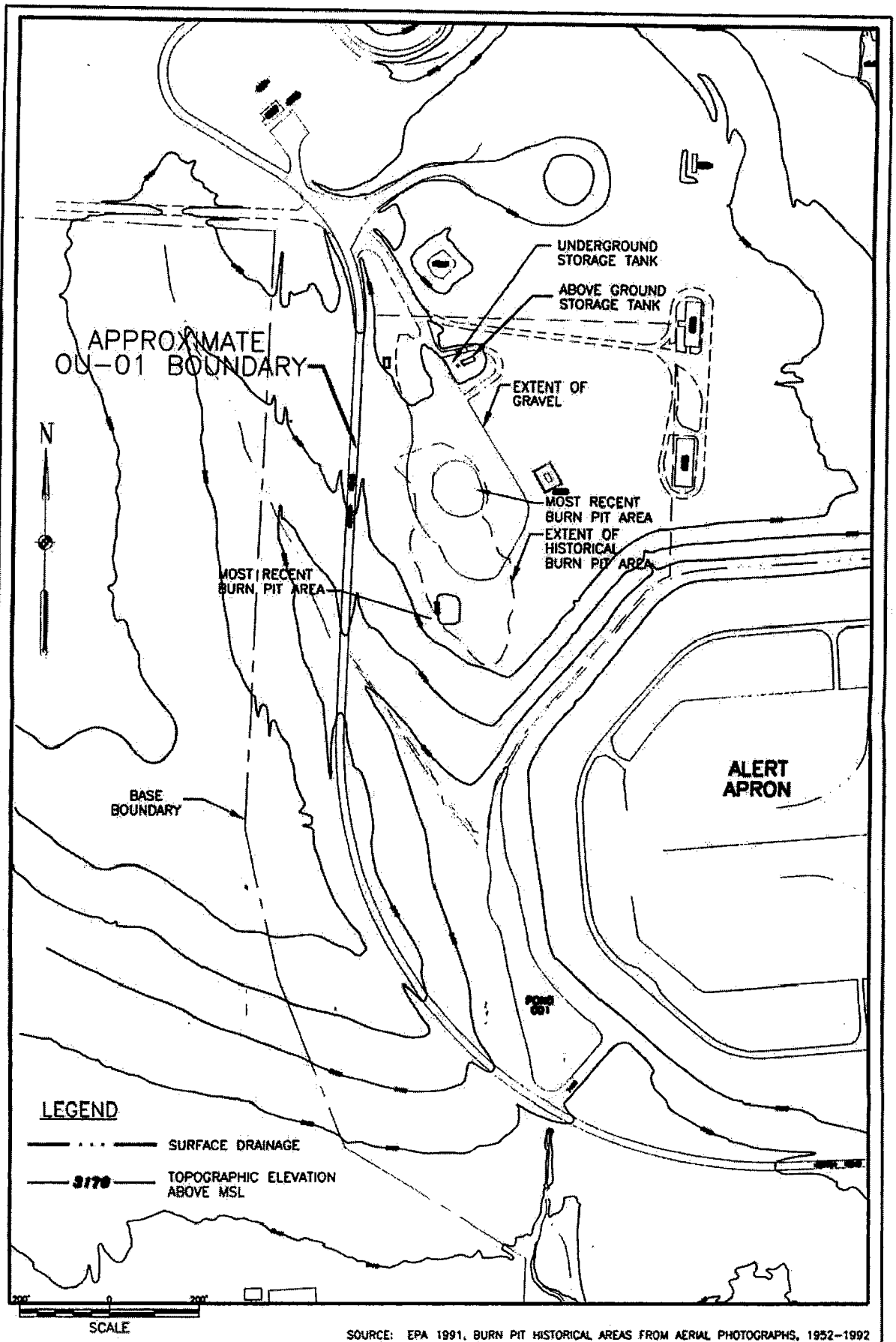
SITE LOCATION MAP

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE:
		STAFF		AS SHOWN	OCT 94	60378.86	3-2

DRAWING NAME: D:\ellsworth\ou7\BGWELL1.DWG
DATE:07/20/2000 TIME:15:05

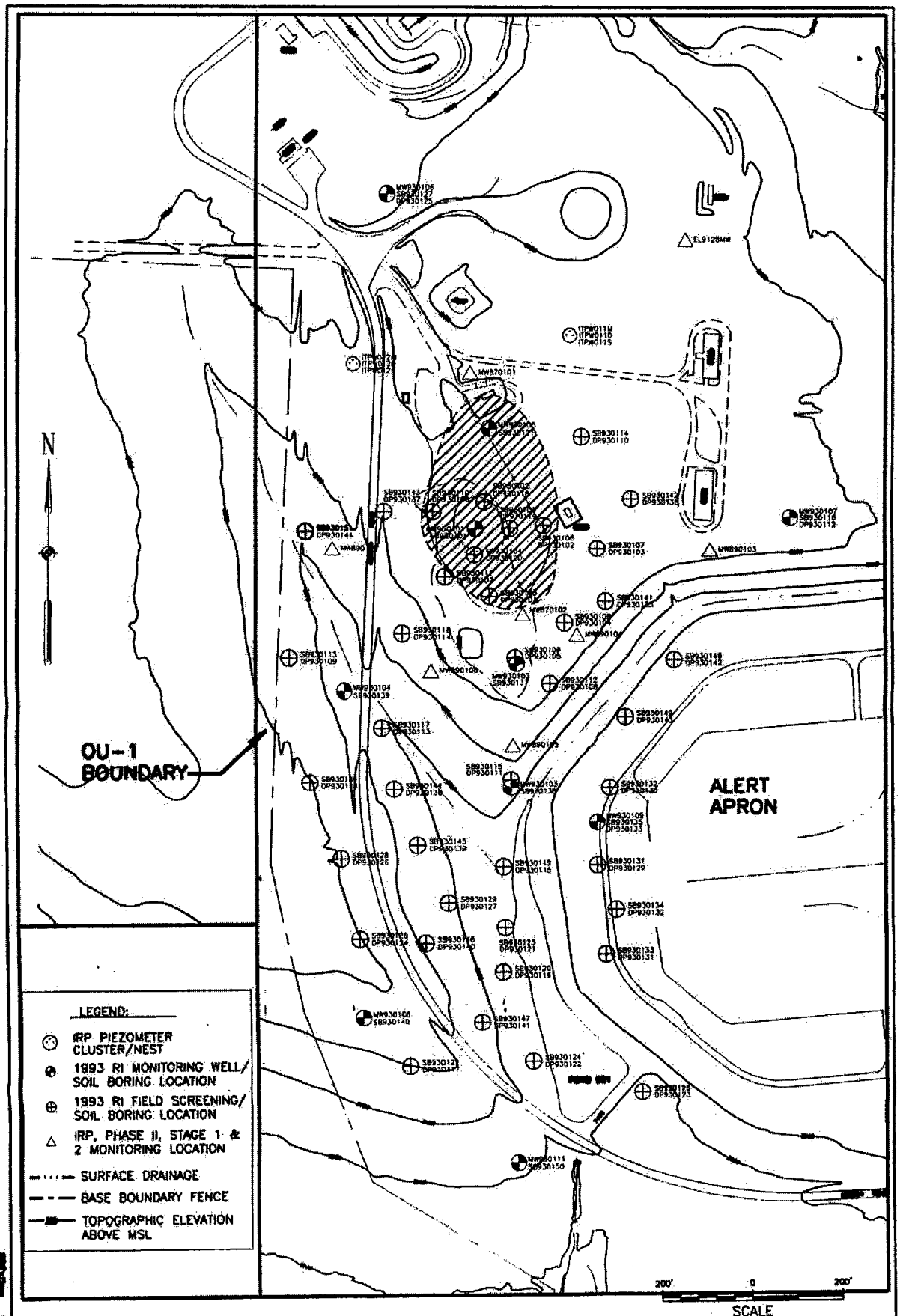


ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA				SURFACE DRAINAGE		
PROJECT MGR	DESIGNED BY	DRAWN BY STAFF	CHECKED BY	SCALE AS SHOWN	DATE OCT 94	PROJECT NO 60378.86	FIGURE: 3-3

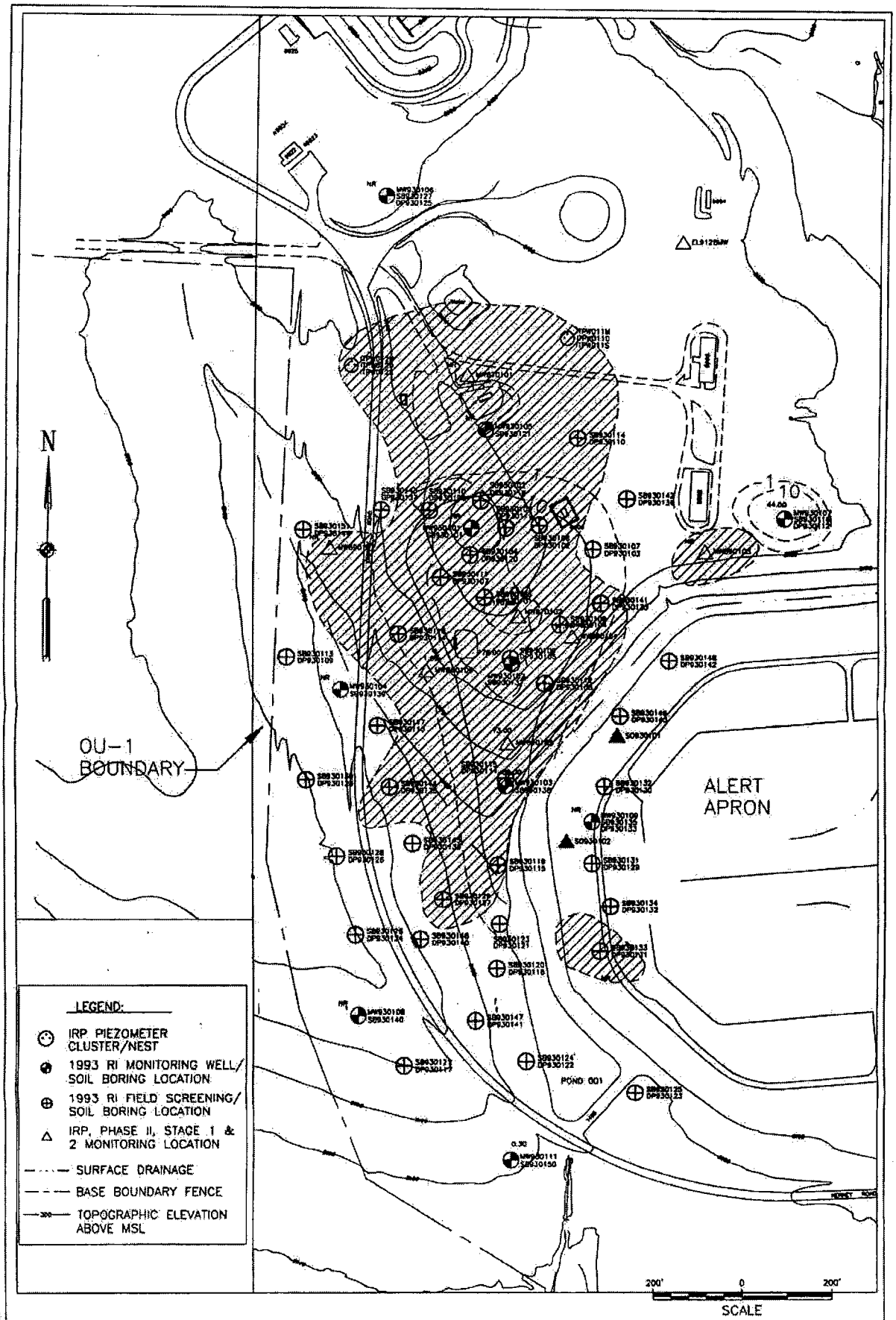


SOURCE: EPA 1991, BURN PIT HISTORICAL AREAS FROM AERIAL PHOTOGRAPHS, 1952-1992

ELLSWORTH AIR FORCE BASE	ELLSWORTH AIR FORCE BASE RAPID CITY, SOUTH DAKOTA	1993 RI OU-1 (FPTA) SITE AREA	DESIGNED BY	DRAWN BY MGL	DATE OCT 94	PROJECT NO. 60378.84
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-4

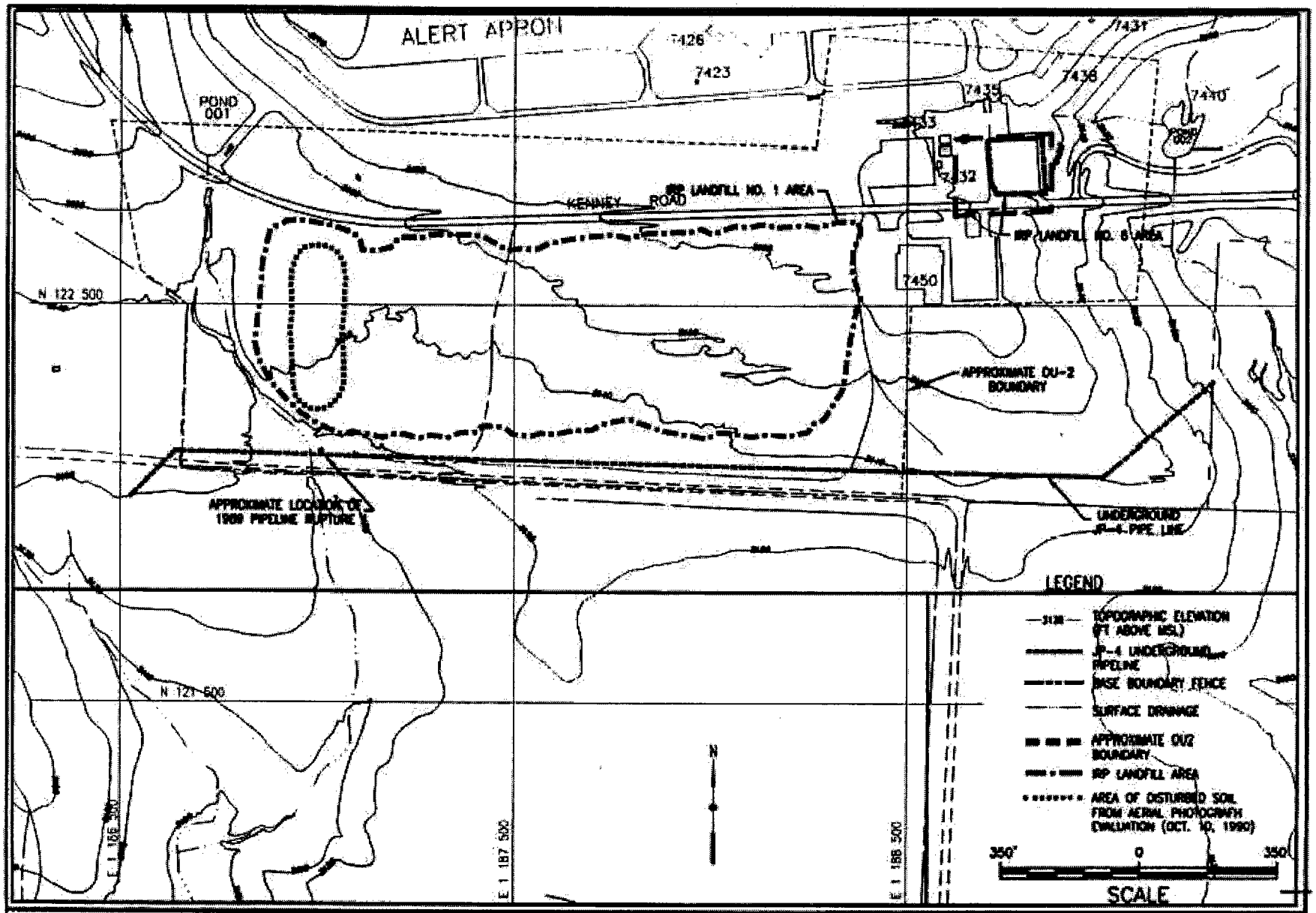


ELLSWORTH AIR FORCE BASE	ELLSWORTH AIR FORCE BASE RAPID CITY, SOUTH DAKOTA	1993 RI EXTENT OF REPORTED COC IN SOIL - BURNPIT AREA OU-01	DESIGNED BY	DRAWN BY MGL	DATE JUNE 95	PROJECT NO. 60378.84
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-5

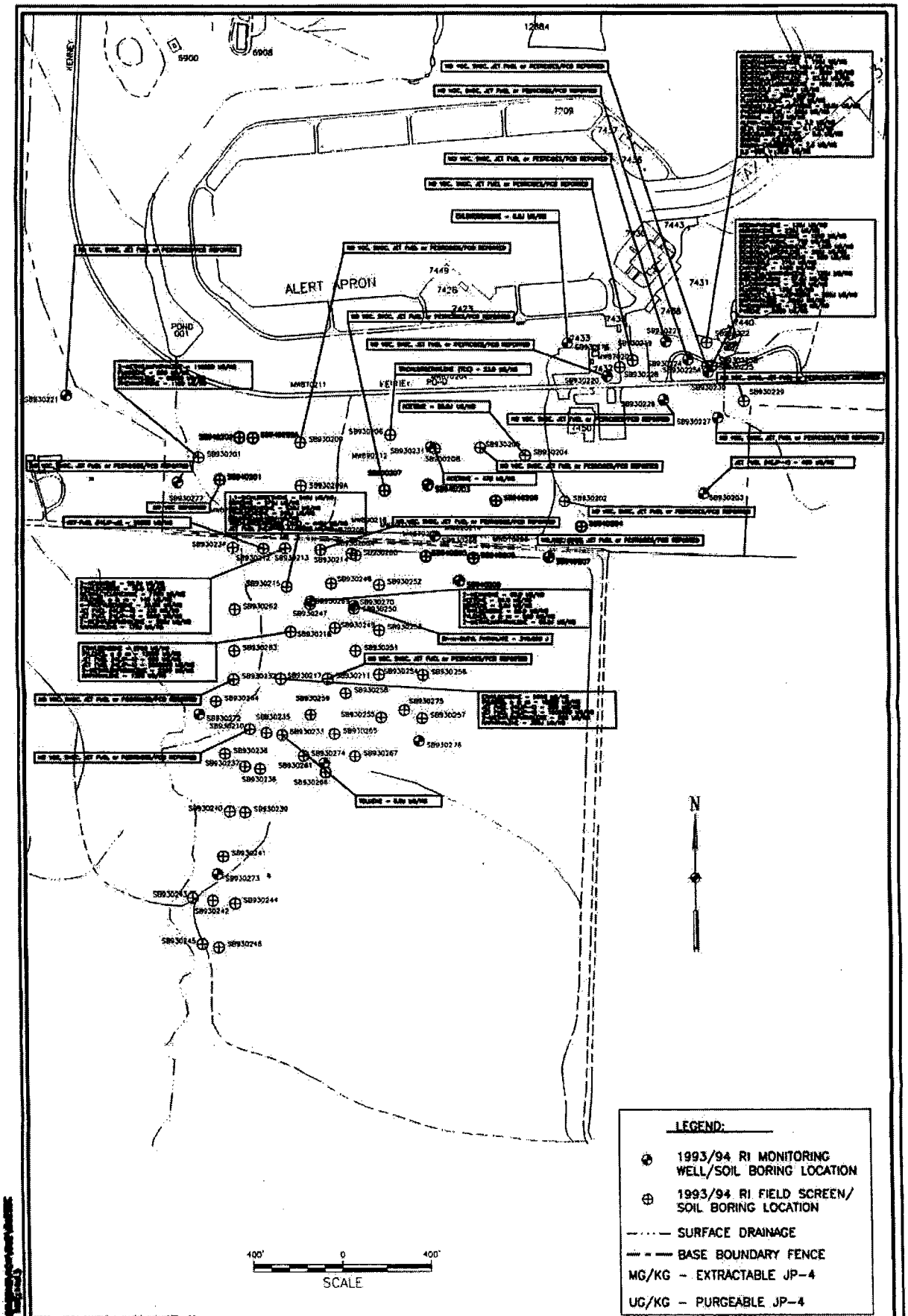


DRAWING NAME: E:\OU1\OU1COC.DWG
DATE:07/20/2000 TIME:14:10

ELLSWORTH AIR FORCE BASE	ELLSWORTH AIR FORCE BASE RAPID CITY, SOUTH DAKOTA	1993 RI EXTENT OF REPORTED COC IN GROUND WATER OU-1	DESIGNED BY	DRAWN BY MGL	DATE JUNE 95	PROJECT NO. 60378.84
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-8

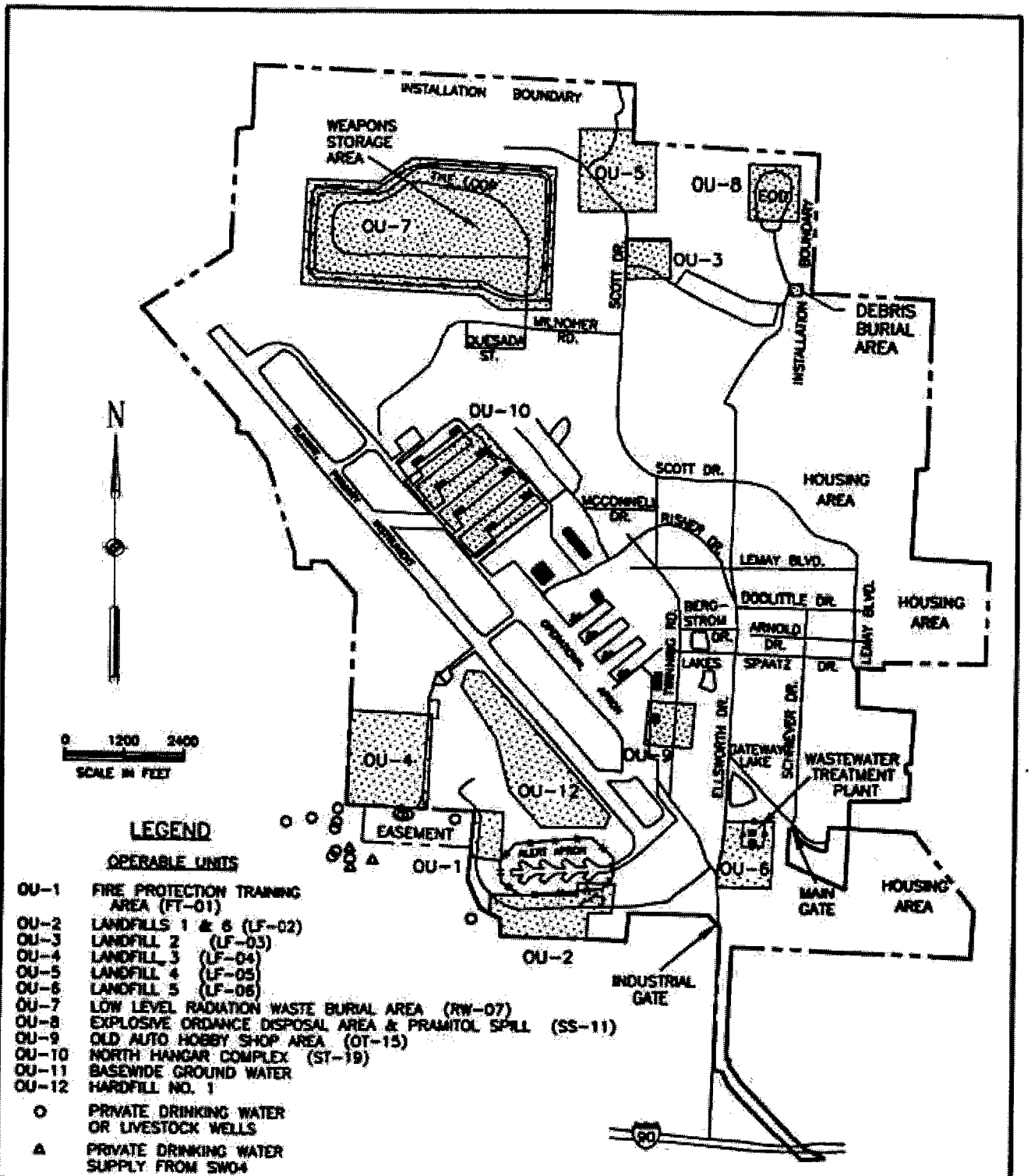


ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	OU-2 SITE AREA	DESIGNED BY	DRAWN BY STAFF	DATE JUN 95	PROJECT NO. 60378.84
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-7



NOTE: 1994 SAMPLE ANALYSIS INCLUDED VOC.
1993 SAMPLE ANALYSIS INCLUDED VOC, SVOC, AND PESTICIDES/PCB

ELLSWORTH AIR FORCE BASE	ELLSWORTH AIR FORCE BASE RAPID CITY, SOUTH DAKOTA	VOC, SVOC, JET FUEL AND PESTICIDES/PCB IN CAPILLARY FRINGE OU-2	DESIGNED BY	DRAWN BY STAFF	DATE JUN 95	PROJECT NO. 60378.84
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-8



LEGEND

OPERABLE UNITS

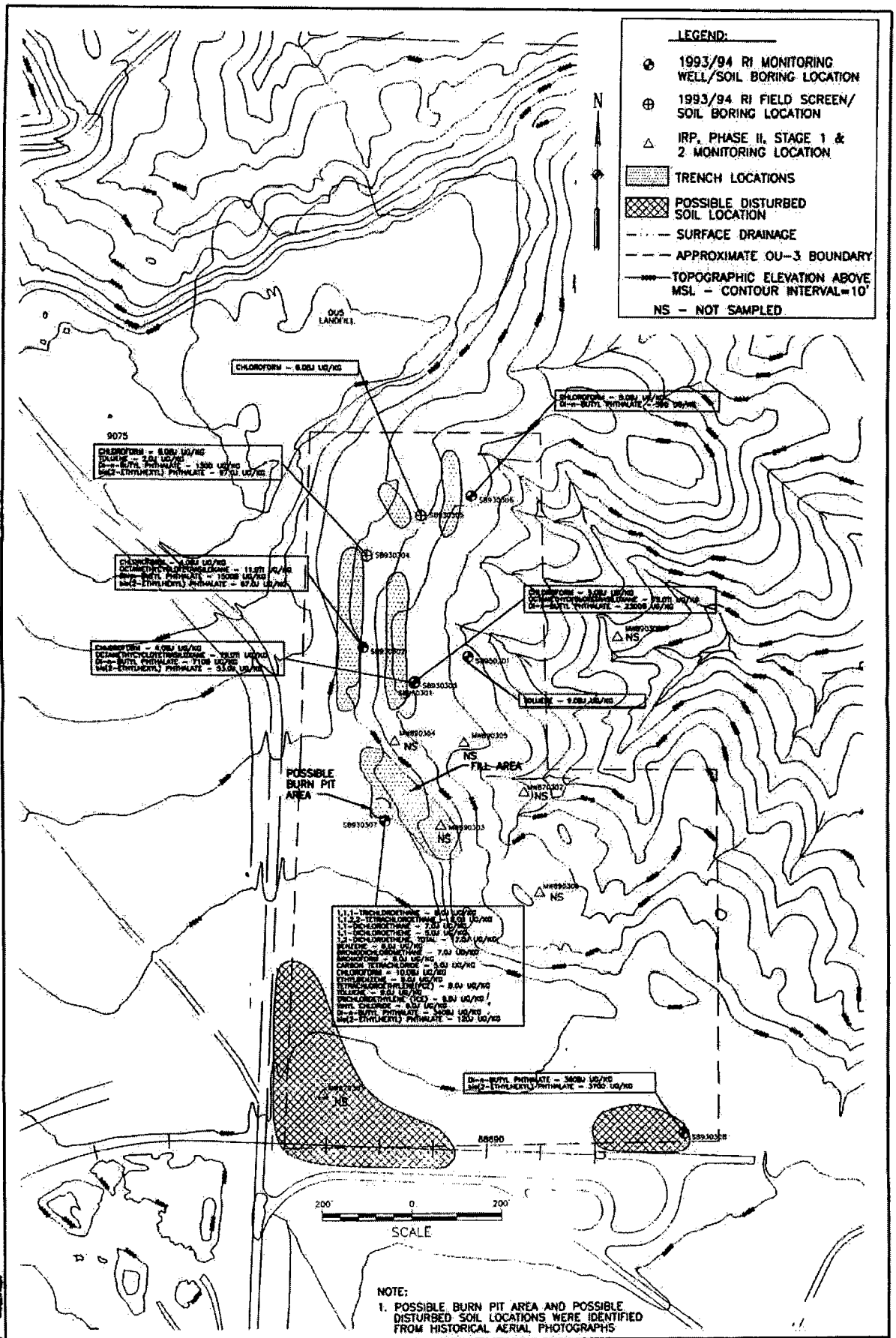
OU-1	FIRE PROTECTION TRAINING AREA (FT-01)
OU-2	LANDFILLS 1 & 6 (LF-02)
OU-3	LANDFILL 2 (LF-03)
OU-4	LANDFILL 3 (LF-04)
OU-5	LANDFILL 4 (LF-05)
OU-6	LANDFILL 5 (LF-06)
OU-7	LOW LEVEL RADIATION WASTE BURIAL AREA (RW-07)
OU-8	EXPLOSIVE ORDANCE DISPOSAL AREA & PRAMITOL SPILL (SS-11)
OU-9	OLD AUTO HOBBY SHOP AREA (OT-15)
OU-10	NORTH HANGAR COMPLEX (ST-19)
OU-11	BASEWIDE GROUND WATER
OU-12	HARDFILL NO. 1
O	PRIVATE DRINKING WATER OR LIVESTOCK WELLS
▲	PRIVATE DRINKING WATER SUPPLY FROM SW04

ELLSWORTH AIR FORCE BASE

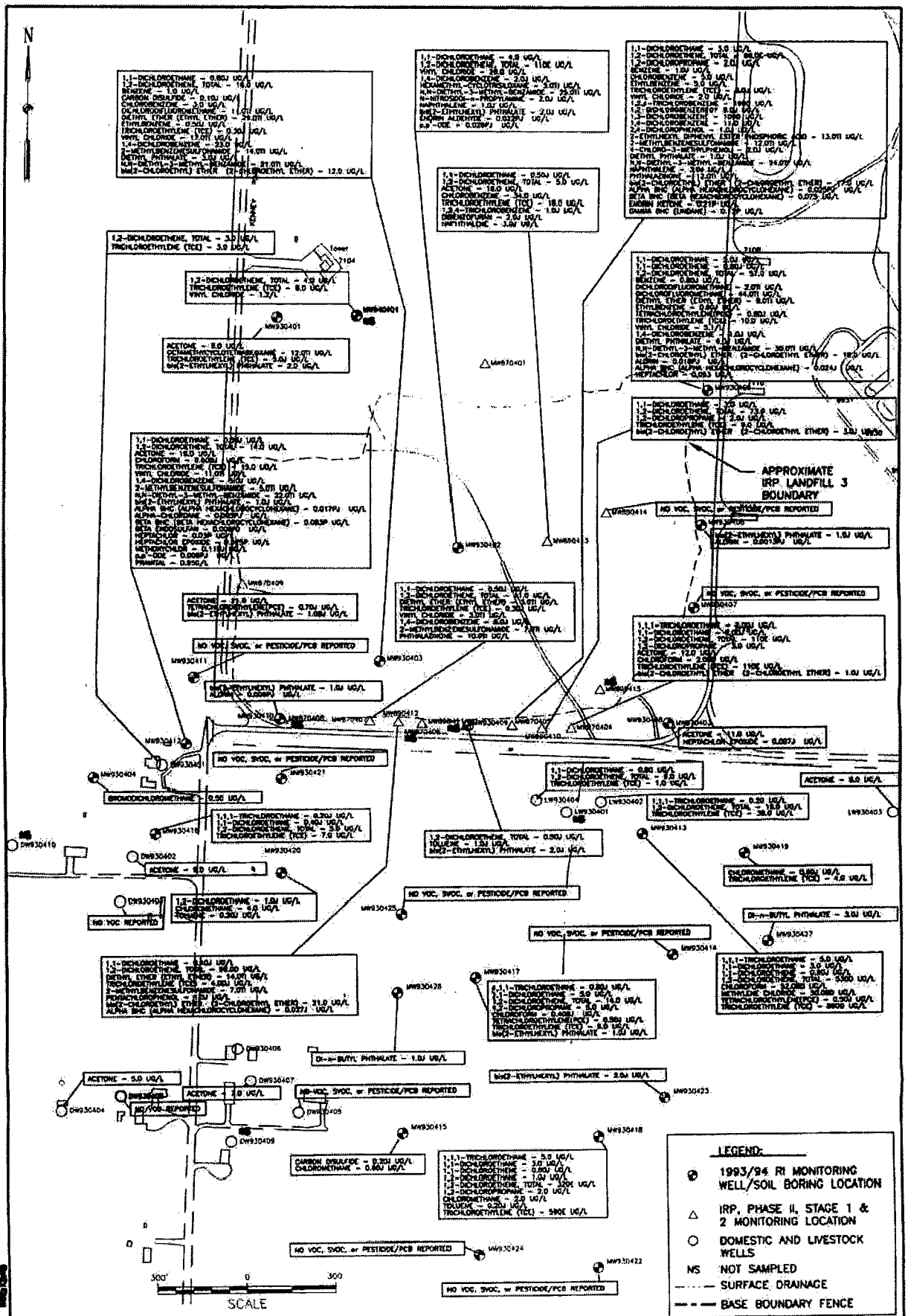
ELLSWORTH AFB
RAPID CITY, SOUTH DAKOTA

1993/94 LOCATION OF PRIVATE AND DOMESTIC WELLS

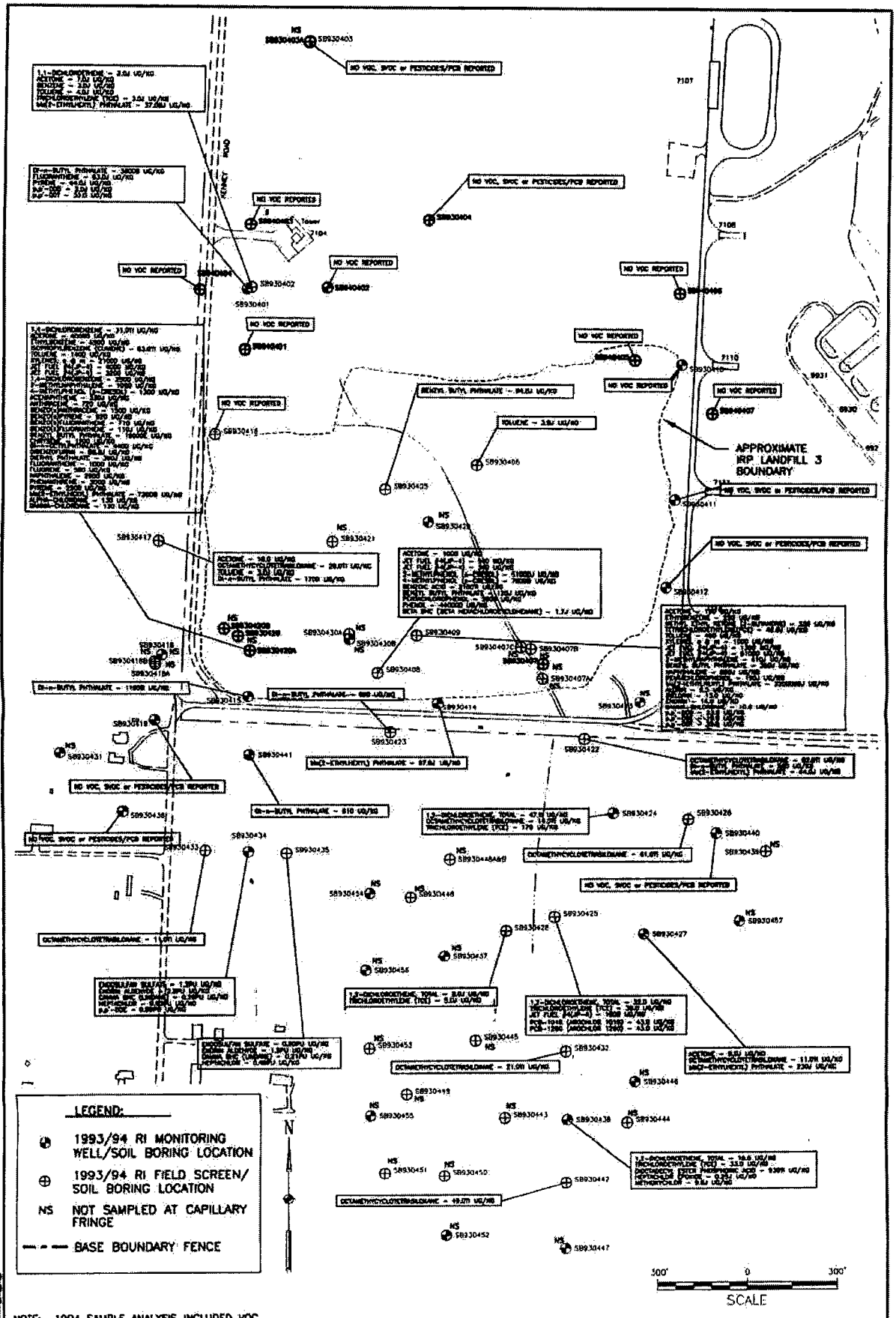
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE:
		STAFF		AS SHOWN	OCT 94	60378.86	3-9



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	OU-3 REPORTED VOC, SVOC, & PESTICIDE/PCB- CAPILLARY FRINGE	DESIGNED BY	DRAWN BY MGL	DATE OCT 94	PROJECT NO. 60378.86
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-10

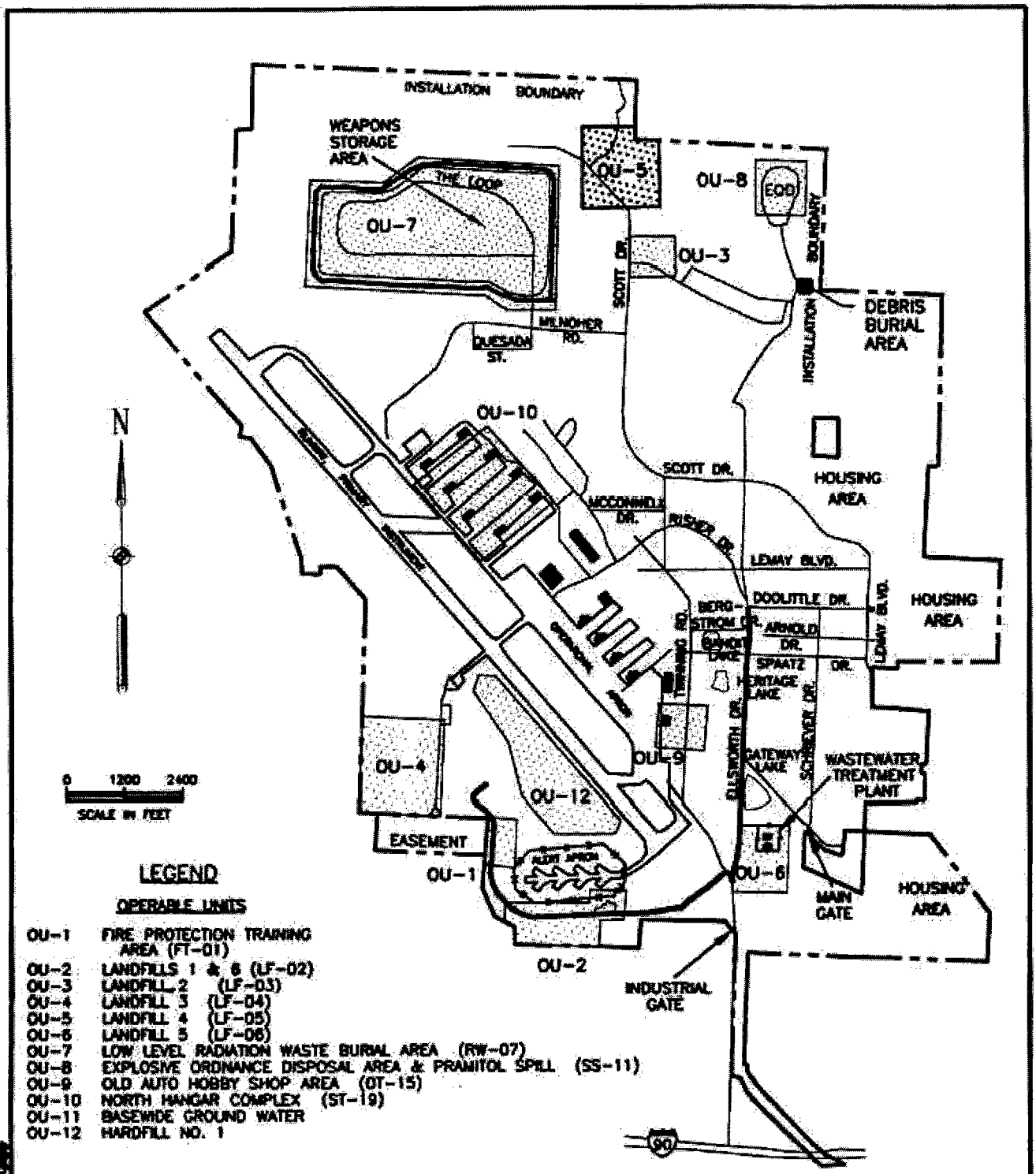


ELLSWORTH AIR FORCE BASE	ELLSWORTH AIR FORCE BASE RAPID CITY, SOUTH DAKOTA	VOC, SVOC AND PESTICIDES/PCB IN MONITORING WELLS OU-04	DESIGNED BY	DRAWN BY	DATE: APR 94
			CHECKED BY	PROJECT MGR.	SCALE: AS SHOWN
					PROJECT NO.: 60378.83
					SHEET NO.: 3-11



NOTE: 1994 SAMPLE ANALYSIS INCLUDED VOC
1993 SAMPLE ANALYSIS INCLUDED VOC, SVOC, AND PESTICIDES\PCB

ELLSWORTH AIR FORCE BASE	ELLSWORTH AIR FORCE BASE RAPID CITY, SOUTH DAKOTA	VOC, SVOC AND PESTICIDES/PCB IN CAPILLARY FRINGE OU-4	DESIGNED BY	DRAWN BY	DATE: OCT 94 / PROJECT NO.: 60378.83
			CHECKED BY	PROJECT MGR.	SCALE: AS SHOWN / SHEET NO.: 3-12



LEGEND

OPERABLE UNITS

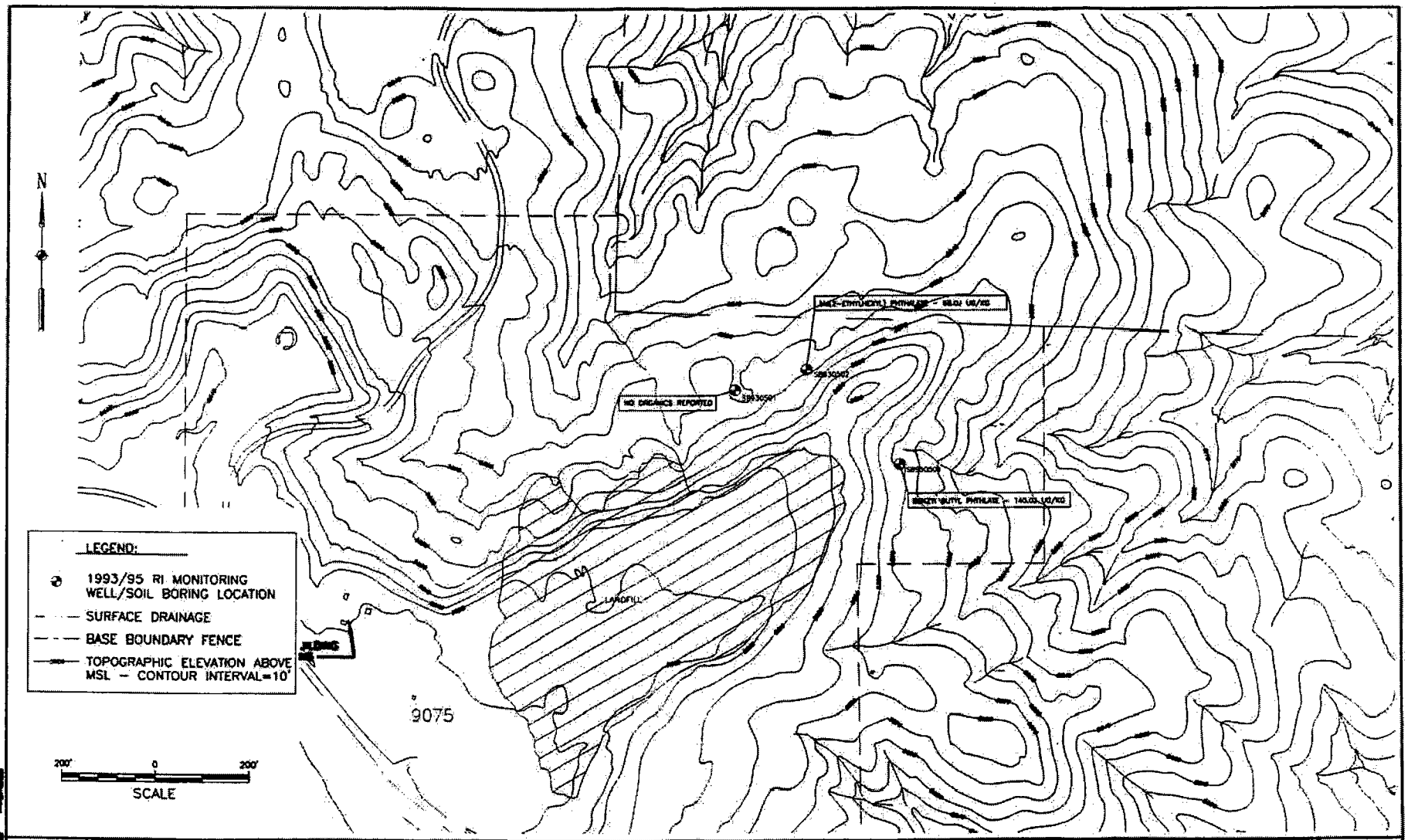
OU-1	FIRE PROTECTION TRAINING AREA (FT-01)
OU-2	LANDFILLS 1 & 6 (LF-02)
OU-3	LANDFILL 2 (LF-03)
OU-4	LANDFILL 3 (LF-04)
OU-5	LANDFILL 4 (LF-05)
OU-6	LANDFILL 5 (LF-06)
OU-7	LOW LEVEL RADIATION WASTE BURIAL AREA (RW-07)
OU-8	EXPLOSIVE ORDINANCE DISPOSAL AREA & PRAMITOL SPILL (SS-11)
OU-9	OLD AUTO HOBBY SHOP AREA (OT-15)
OU-10	NORTH HANGAR COMPLEX (ST-19)
OU-11	BASEWIDE GROUND WATER
OU-12	HARDFILL NO. 1

ELLSWORTH AIR FORCE BASE

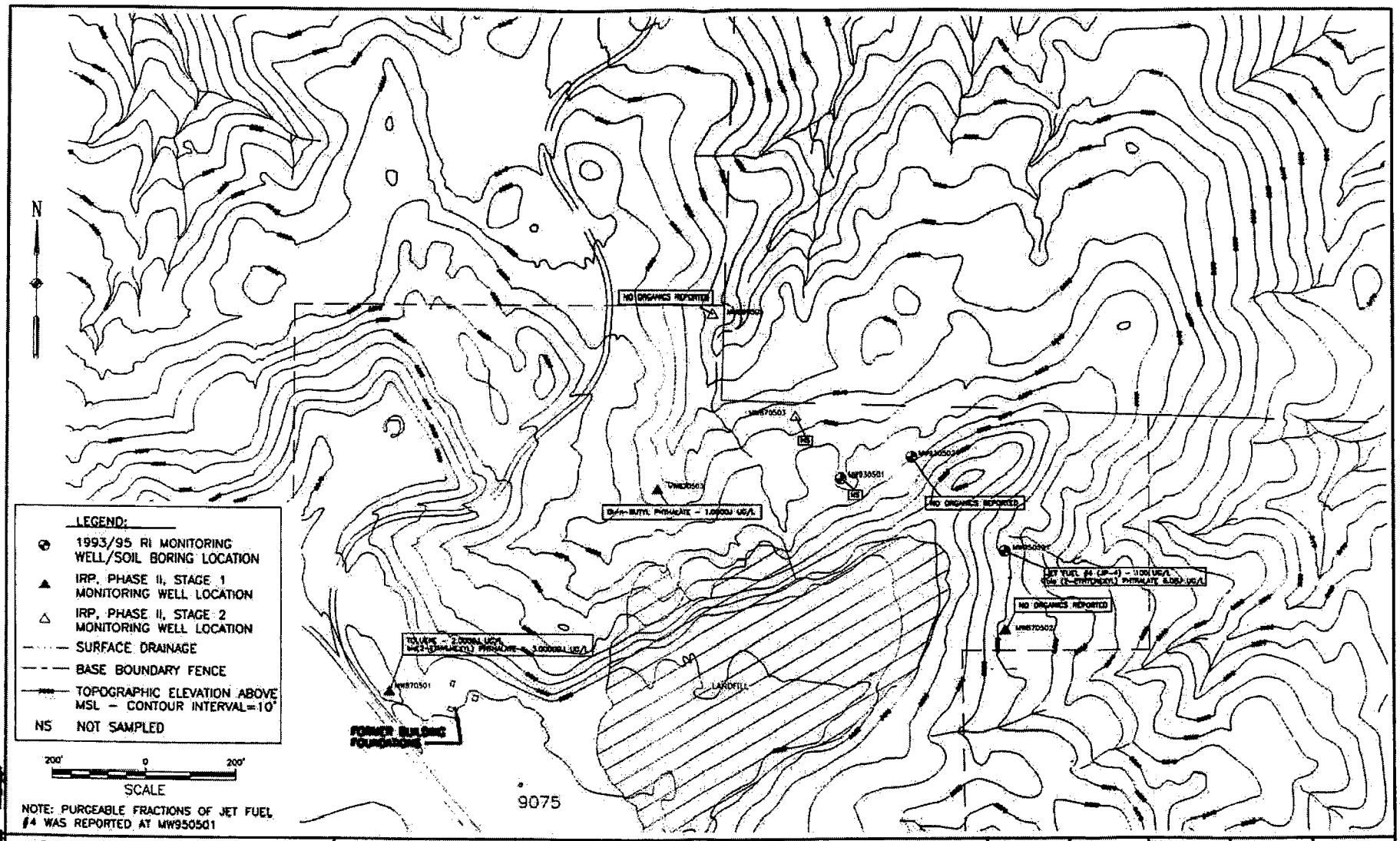
ELLSWORTH AFB
RAPID CITY, SOUTH DAKOTA

SITE LOCATION MAP

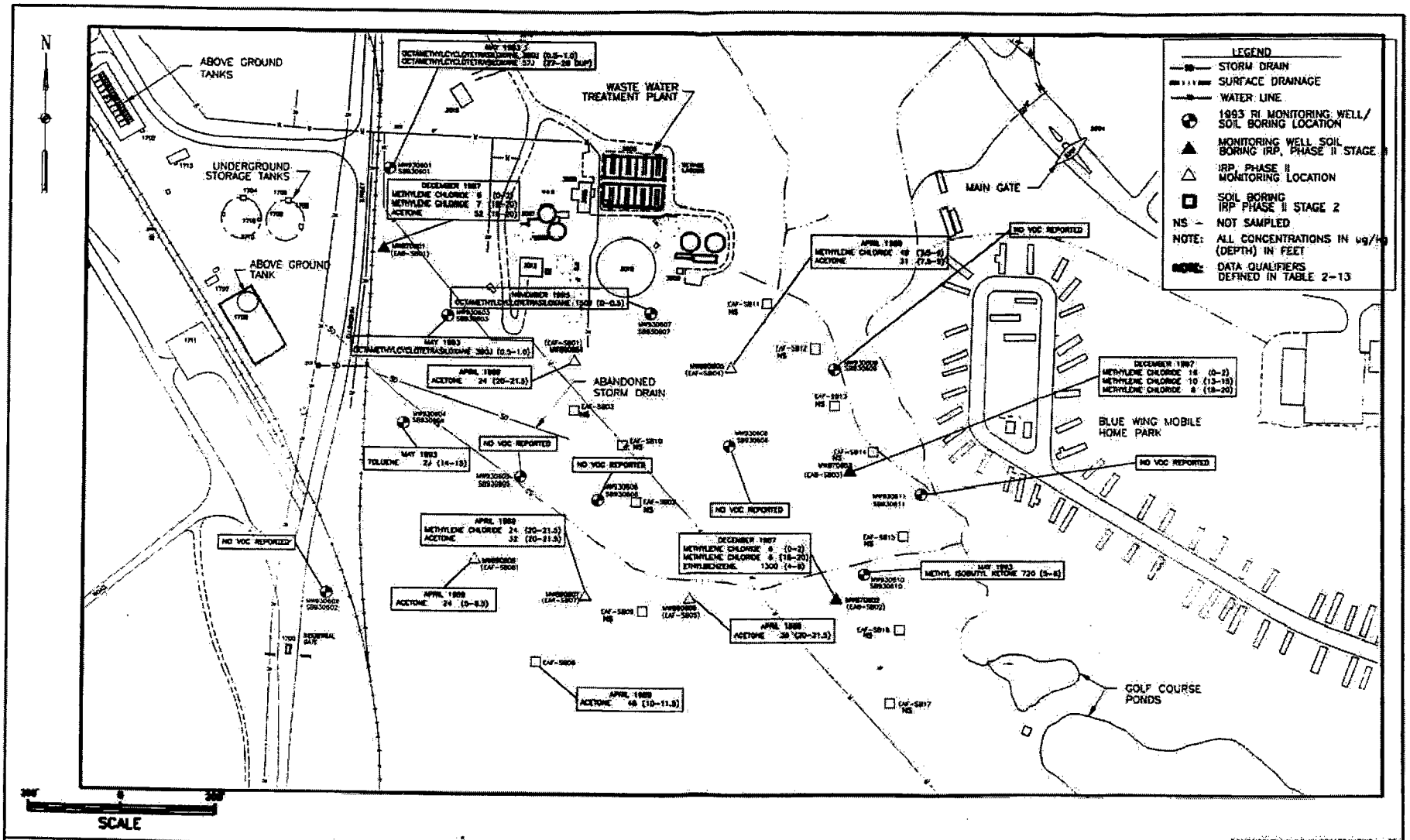
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE:
		STAFF		AS SHOWN	OCT 94	60378.86	3-13



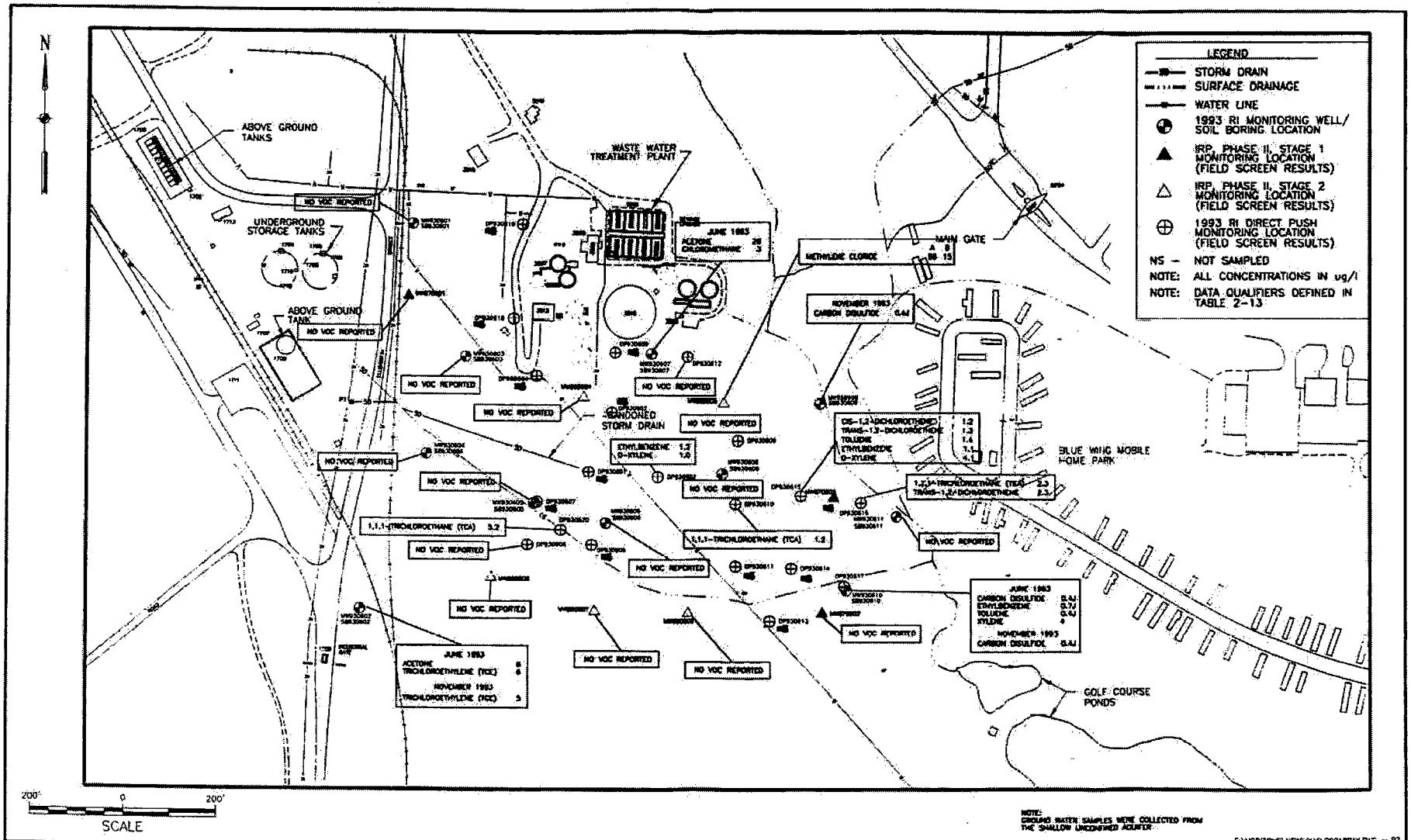
ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB SOUTH DAKOTA	1993/95 RI REPORTED VOC, SVOC, PESTICIDE/PCB– CAPILLARY FRINGE SOIL, OU-5	DESIGNED BY	DRAWN BY MGL	DATE OCT 94	PROJECT NO. 60378.86	FILE NAME
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	DRAWING NO.	FIGURE 3-14



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB SOUTH DAKOTA	1993/95 RI REPORTED VOC, SVOC, PESTICIDE/PCB– MONITORING WELLS, OU-5	DESIGNED BY	DRAWN BY MGL	DATE OCT 94	PROJECT NO. 60378.86	FILE NAME	
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	DRAWING NO.	FIGURE 3-15	

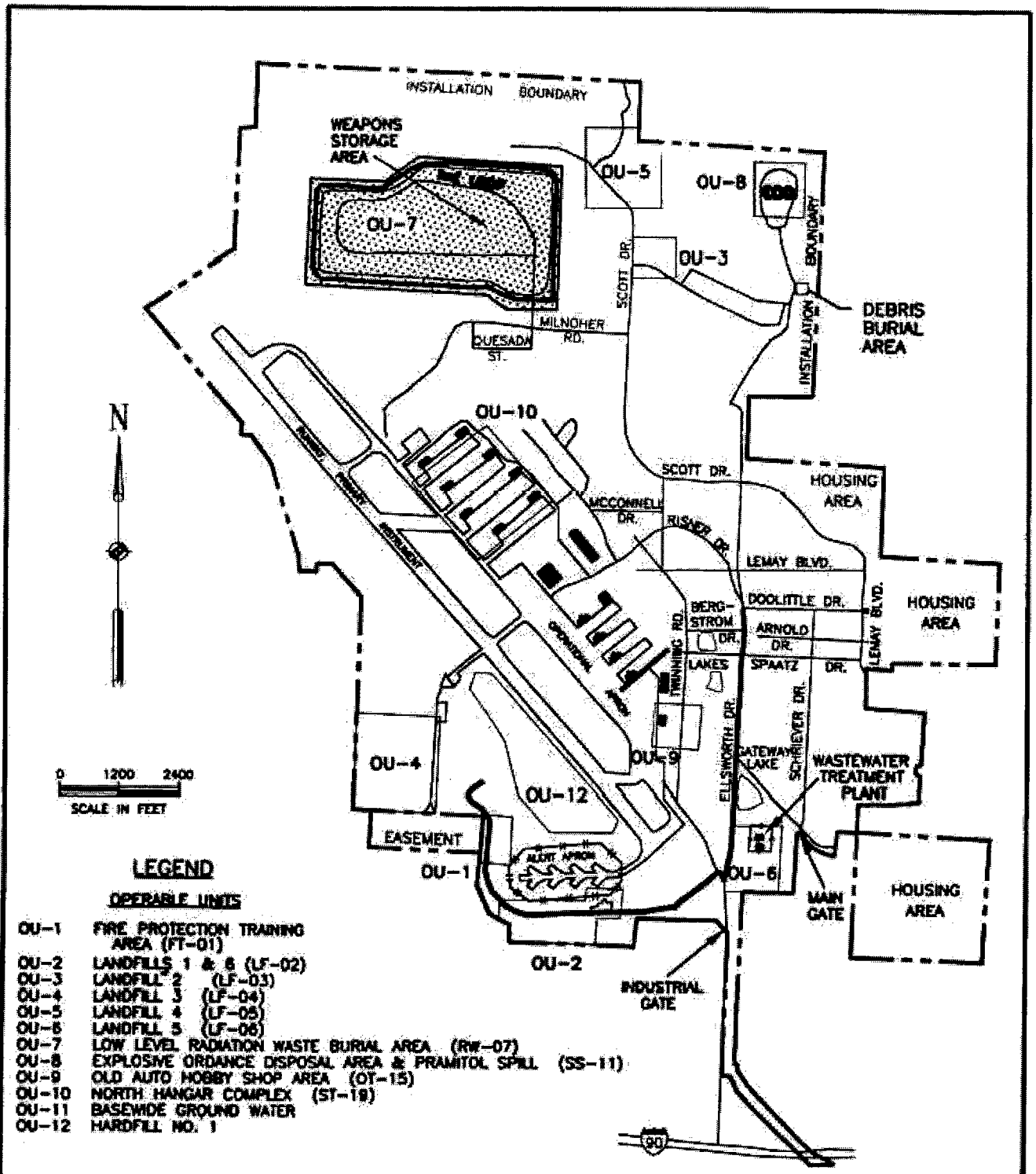


ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	1993 RI REPORTED VOC-IRP AND SOIL BORINGS (VALUE W/DEPTH) OU-6	DESIGNED BY	DRAWN BY MGL	DATE FEB 94	PROJECT NO. 60378.81	FILE NAME
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE NO. 3-16	SHEET NO.



F:\HORIZONS\NEW\GU6\200ARRAY.DWG - 92

ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	1993 RI REPORTED VOC-FIELD SCREENING AND MONITORING WELLS OU-6	DESIGNED BY	DRAWN BY MGL	DATE FEB 94	PROJECT NO. 60378.81	FILE NAME
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE NO. 3-17	SHEET NO.



LEGEND

OPERABLE UNITS

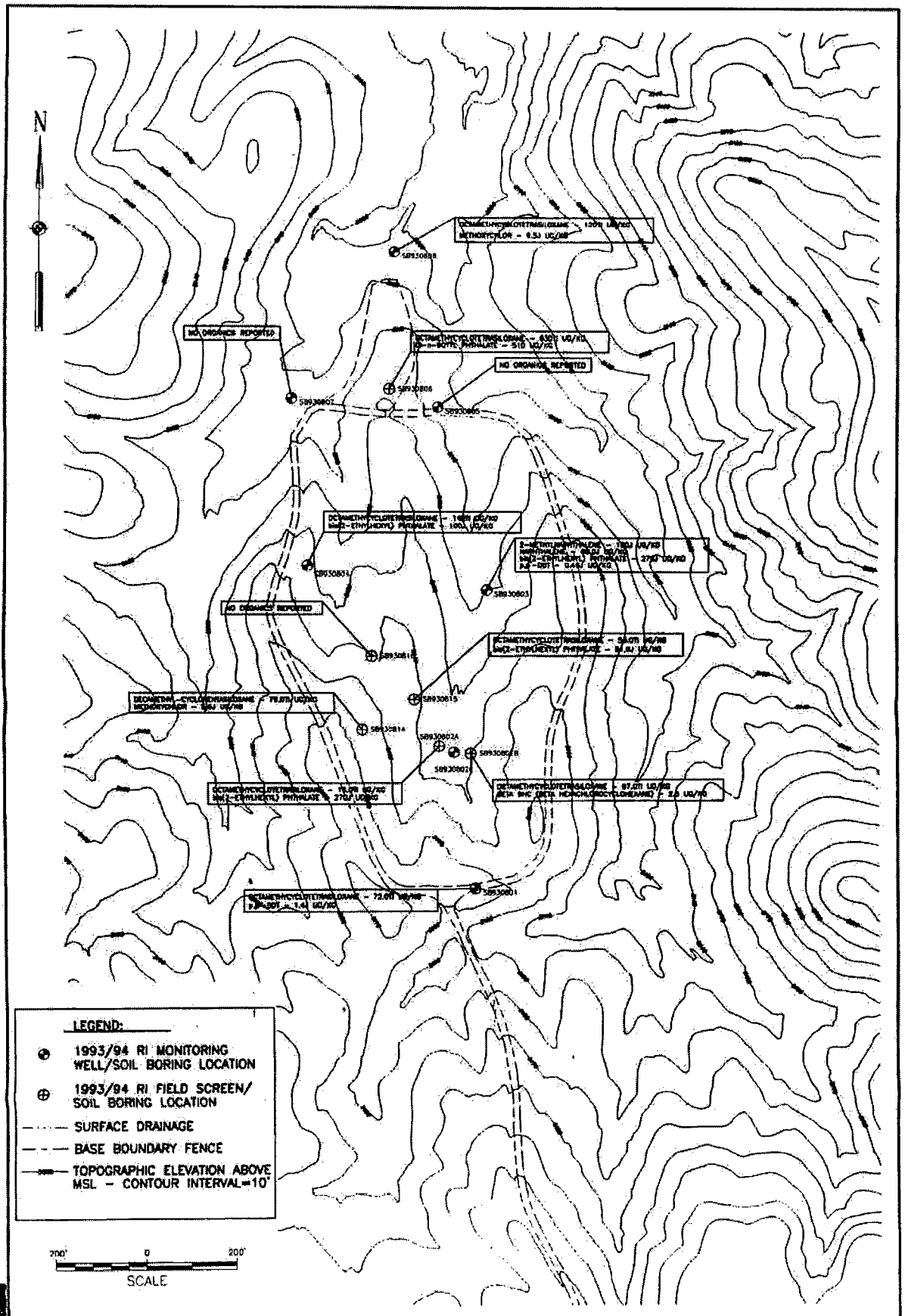
OU-1	FIRE PROTECTION TRAINING AREA (FT-01)
OU-2	LANDFILLS 1 & 6 (LF-02)
OU-3	LANDFILL 2 (LF-03)
OU-4	LANDFILL 3 (LF-04)
OU-5	LANDFILL 4 (LF-05)
OU-6	LANDFILL 5 (LF-06)
OU-7	LOW LEVEL RADIATION WASTE BURIAL AREA (RW-07)
OU-8	EXPLOSIVE ORDANCE DISPOSAL AREA & PRAMITOL SPILL (SS-11)
OU-9	OLD AUTO HOBBY SHOP AREA (OT-15)
OU-10	NORTH HANGAR COMPLEX (ST-19)
OU-11	BASEWIDE GROUND WATER
OU-12	HARDFILL NO. 1

ELLSWORTH AIR FORCE BASE

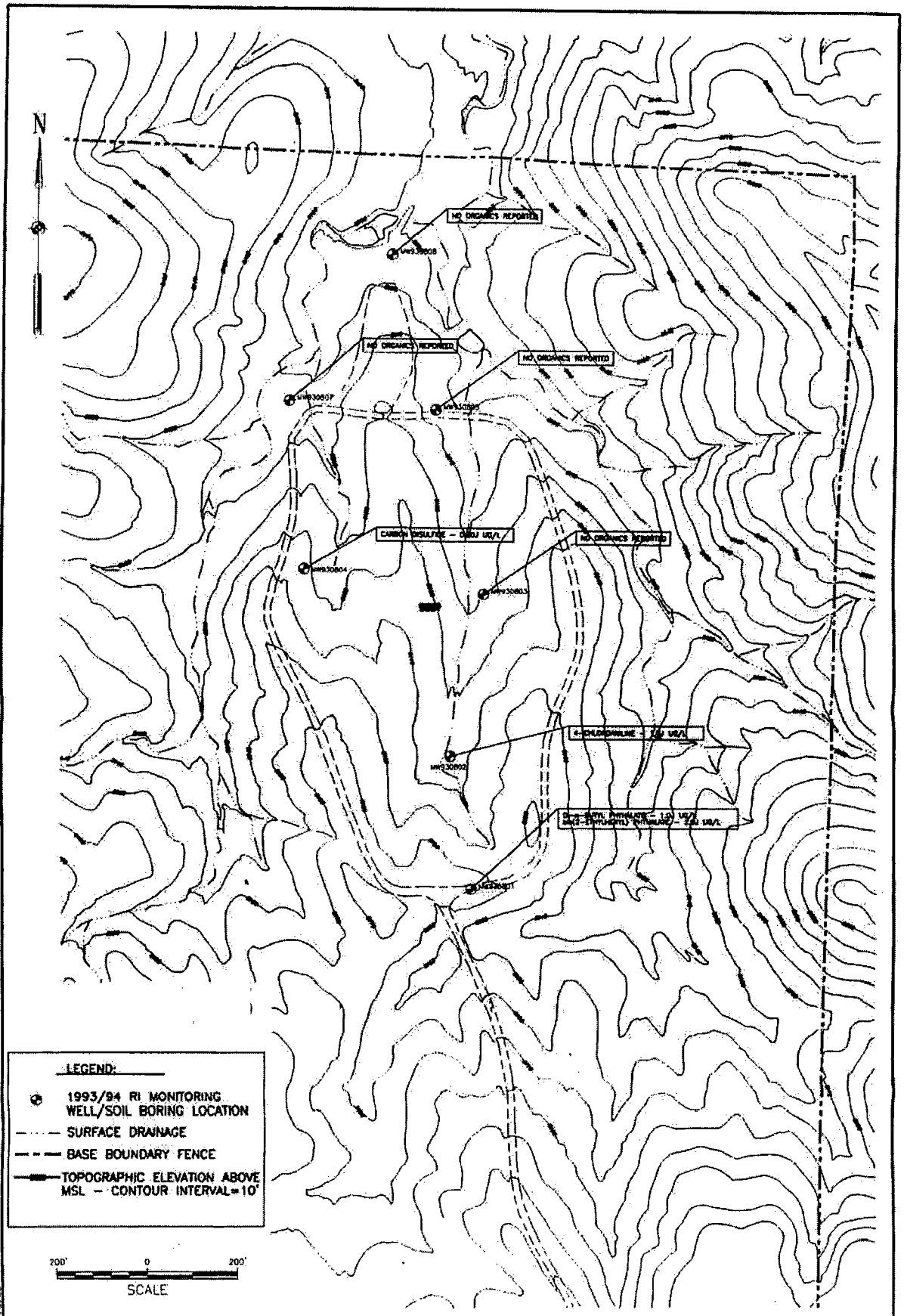
ELLSWORTH AFB
RAPID CITY, SOUTH DAKOTA

SITE LOCATION MAP

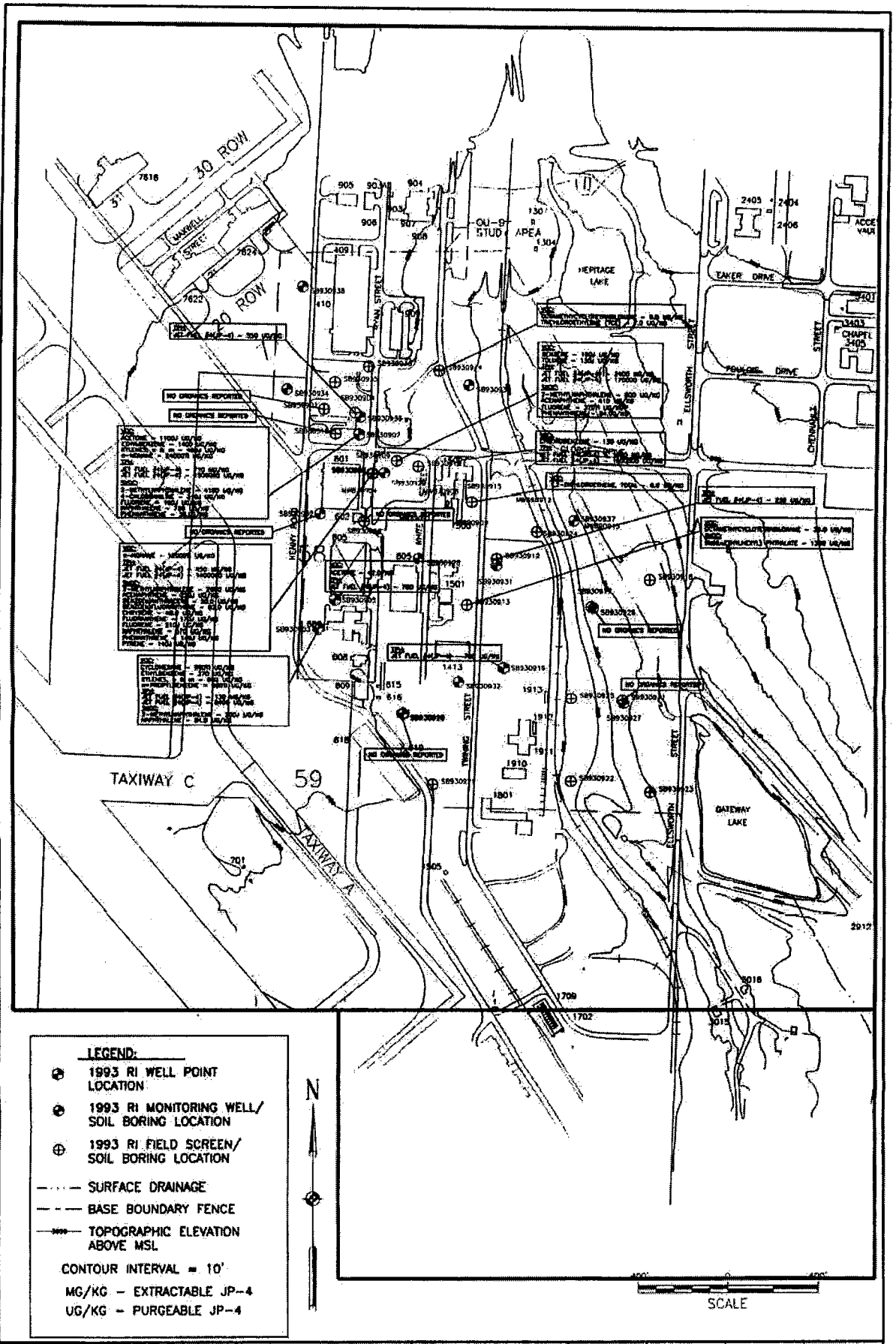
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE:
		STAFF		AS SHOWN	OCT 94	60378.86	3-18



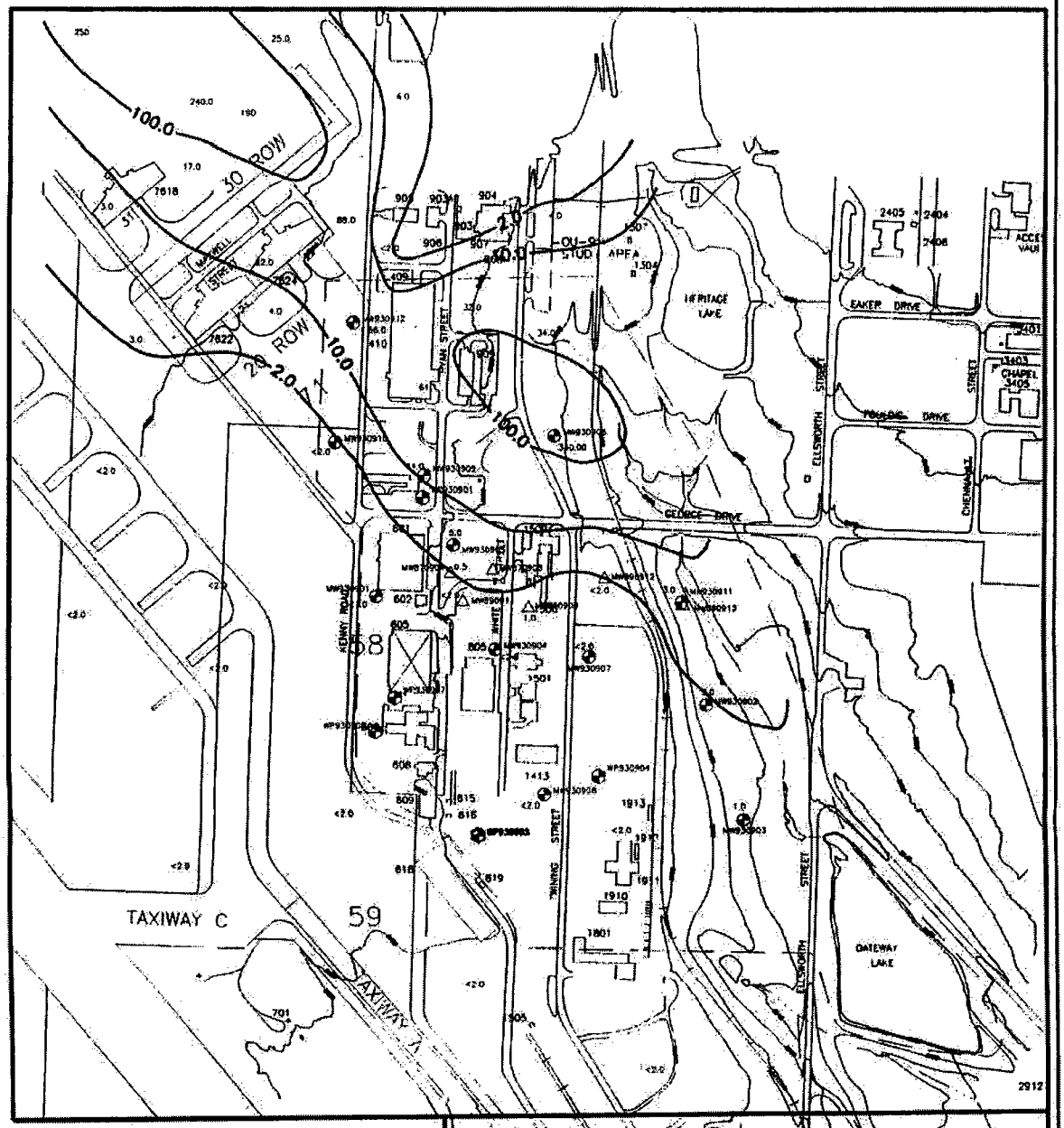
ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	1993/94 RI REPORTED VOC, SVOC, PESTICIDES/PCB- CAPILLARY FRINGE, OU-B	DESIGNED BY	DRAWN BY MGL	DATE OCT 94	PROJECT NO. 60378.86
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-19



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	1993/94 RI REPORTED VOC, SVOC, PESTICIDES/PCB-MONITORING WELLS, OU-B	DESIGNED BY	DRAWN BY MGL	DATE OCT 94	PROJECT NO. 60378.86
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-20

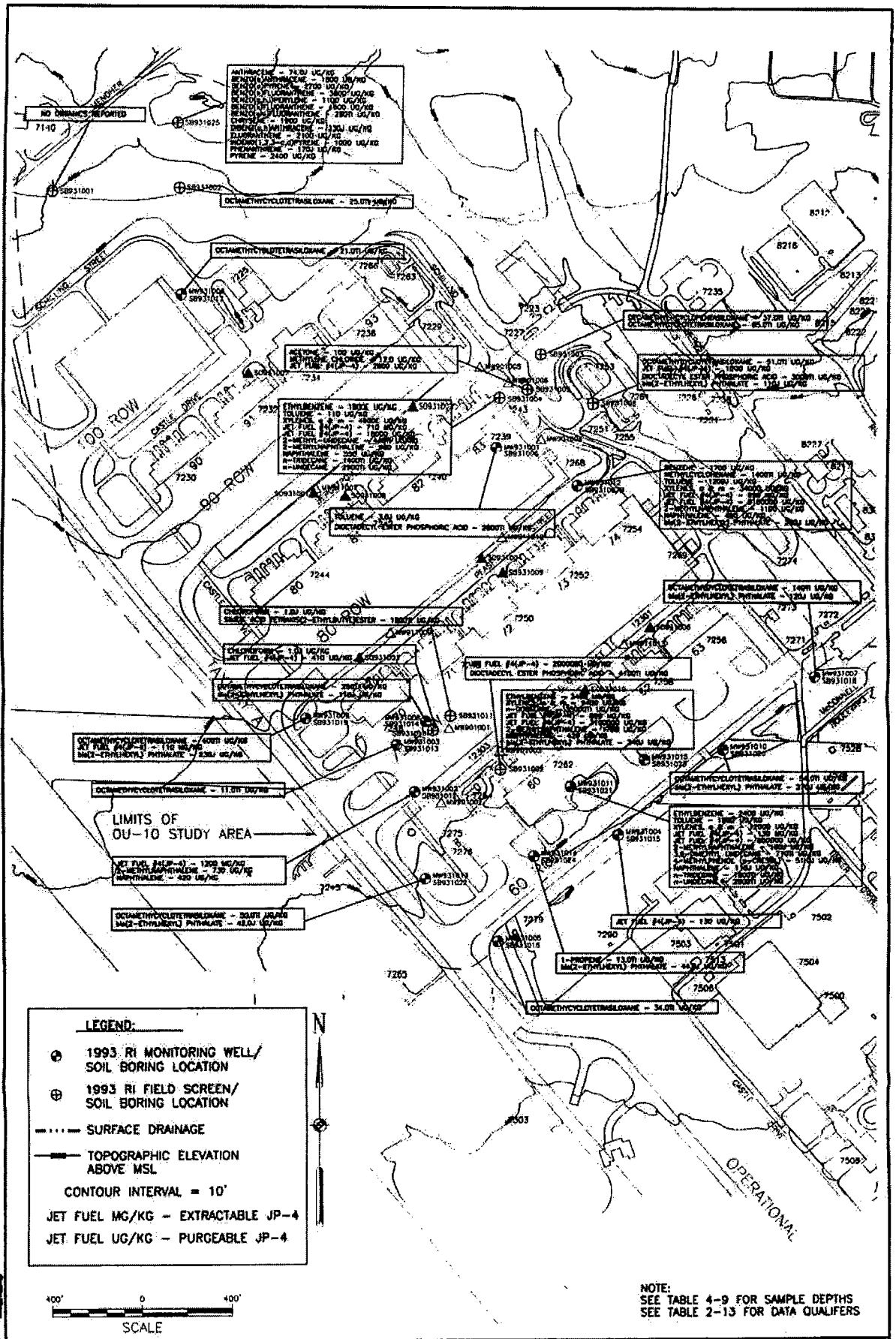


ELLSWORTH AIR FORCE BASE	ELLSWORTH AIR FORCE BASE RAPID CITY, SOUTH DAKOTA	1993 RI REPORTED VOC, SVOC, TPH- CAPILLARY FRINGE OU-9	DESIGNED BY	DRAWN BY	DATE MAY 95	PROJECT NO. 60378.85
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-21

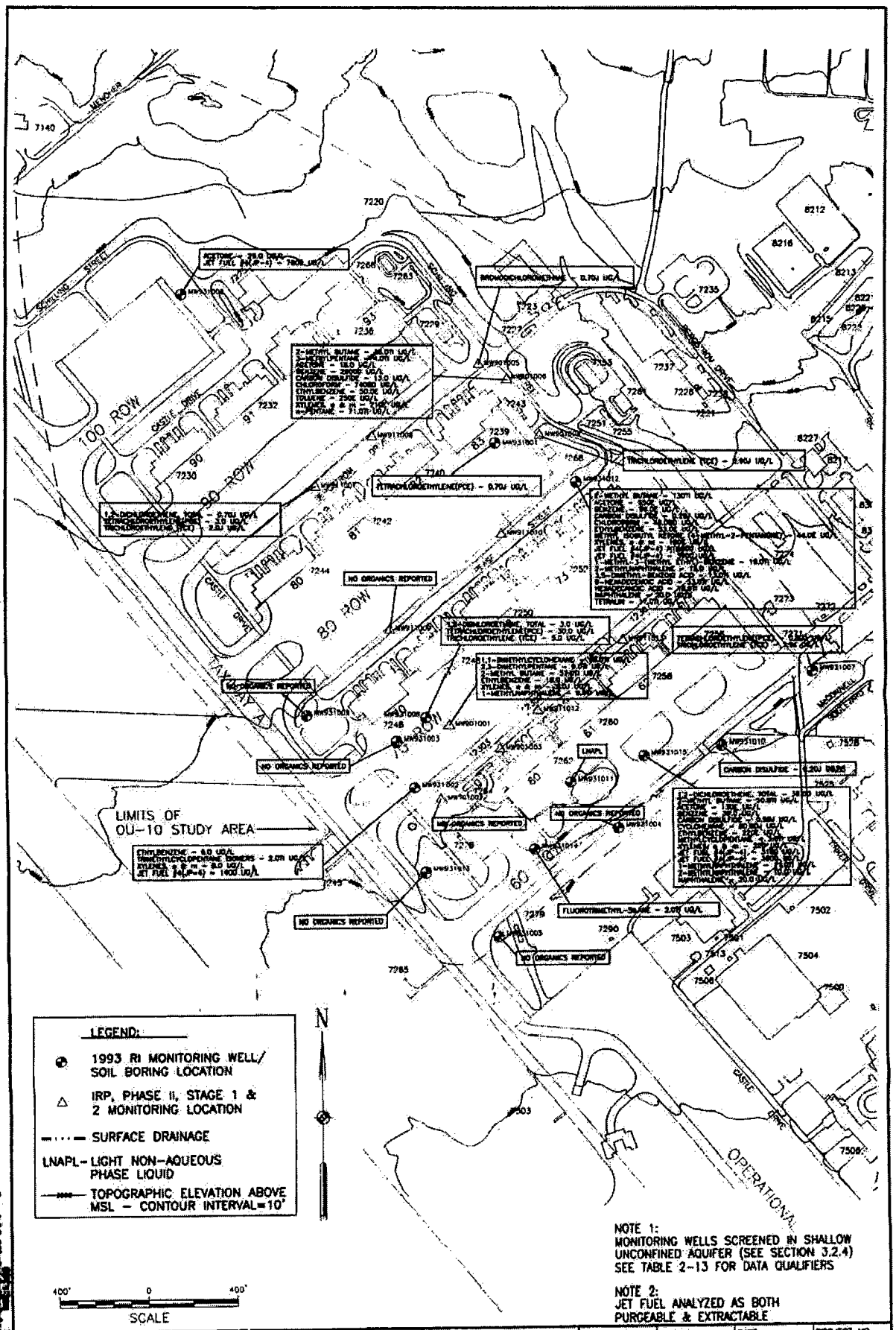


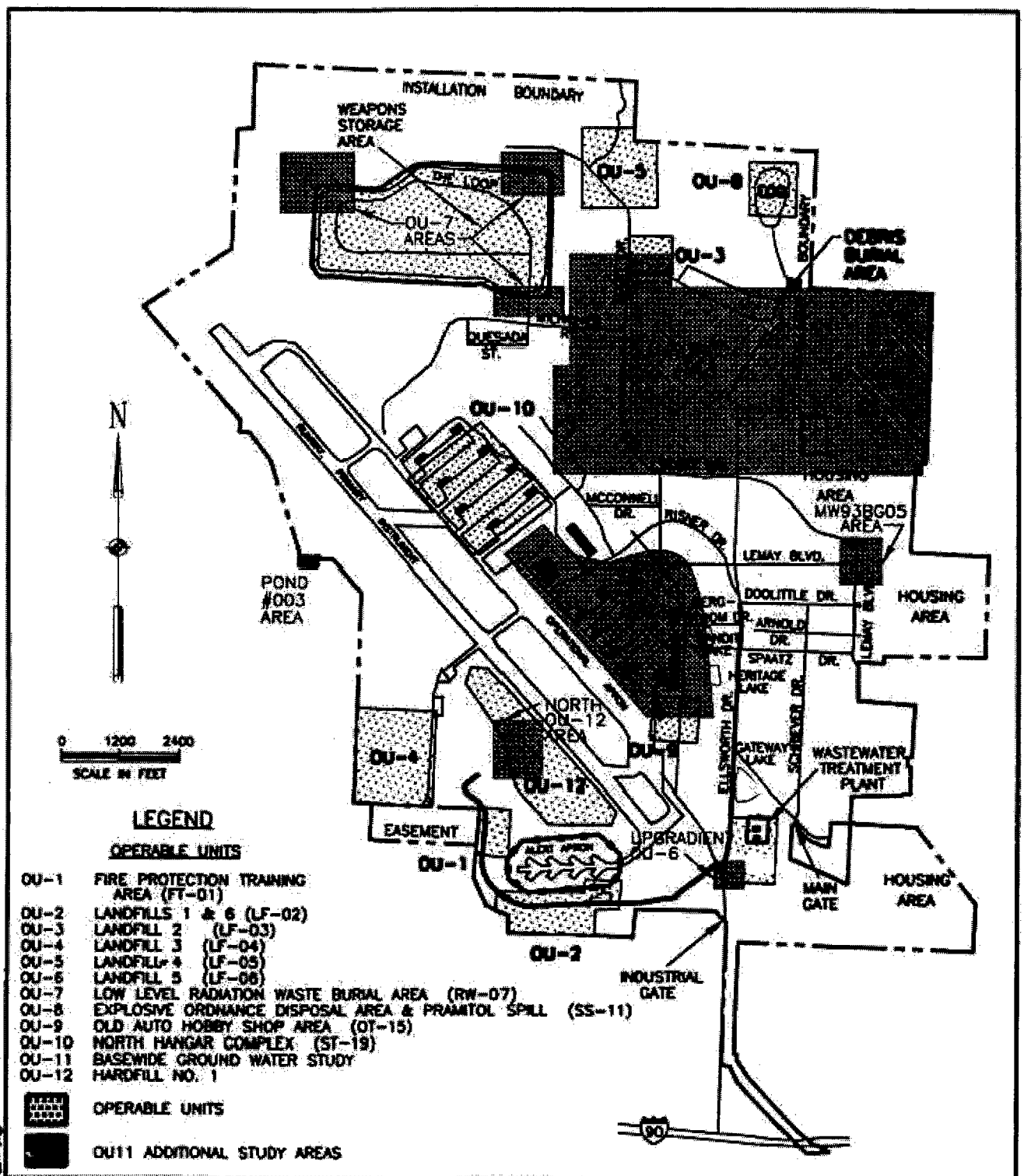
NOTE:
THE SUBSURFACE AREAS SHOWN REPRESENT OUR EVALUATION OF THE MOST PROBABLE CONDITIONS BASED UPON INTERPETATION OF PRESENTLY AVAILABLE DATA. SOME VARIATIONS FROM THESE MUST BE EXPECTED.

ELLSWORTH AIR FORCE BASE	ELLSWORTH AIR FORCE BASE RAPID CITY, SOUTH DAKOTA	1993 RI ISOPLETH MAP TCE CONCENTRATIONS (ug/L) MONITORING WELL SAMPLES FALL 1993 OU-9	DESIGNED BY	DRAWN BY STAFF	DATE MAY 95	PROJECT NO. 60378.85
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-22



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	1993 RI REPORTED VOC, SVOC, TPH, CAPILLARY FRINGE OU-10	DESIGNED BY	DRAWN BY STAFF	DATE OCT 94	PROJECT NO. 60378.85
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-23


LIMITS OF
OU-10 STUDY AREA
NO ORGANICS REPORTED
LNAPL
CARBON DISULFIDE - 4.20J UG/L
FLUOROTRICHLOROMETHANE - 2.0U UG/L
TRICHLOROETHYLENE (TCE) - 0.90J UG/L
TETRACHLOROETHYLENE(PCE) - 0.70J UG/L
BROMODICHLOROMETHANE - 0.70J UG/L
LEGEND:
1993 RI MONITORING WELL/ SOIL BORING LOCATION
IRP, PHASE II, STAGE 1 & 2 MONITORING LOCATION
SURFACE DRAINAGE
LNAPL- LIGHT NON-AQUEOUS PHASE LIQUID
TOPOGRAPHIC ELEVATION ABOVE MSL - CONTOUR INTERVAL=10'
N
400' 0 400'
SCALE
NOTE 1:
MONITORING WELLS SCREENED IN SHALLOW UNCONFINED AQUIFER (SEE SECTION 3.2.4)
SEE TABLE 2-13 FOR DATA QUALIFIERS
NOTE 2:
JET FUEL ANALYZED AS BOTH PURGEABLE & EXTRACTABLE
ELLSWORTH AIR FORCE BASE
ELLSWORTH AFB
RAPID CITY, SOUTH DAKOTA
1993 RI
REPORTED VOC, SVOC, TPH, MONITORING WELLS
OU-10
DESIGNED BY
DRAWN BY
STAFF
DATE
OCT 94
PROJECT NO.
60378.85
CHECKED BY
PROJECT MGR.
SCALE
AS SHOWN
FIGURE
3-24

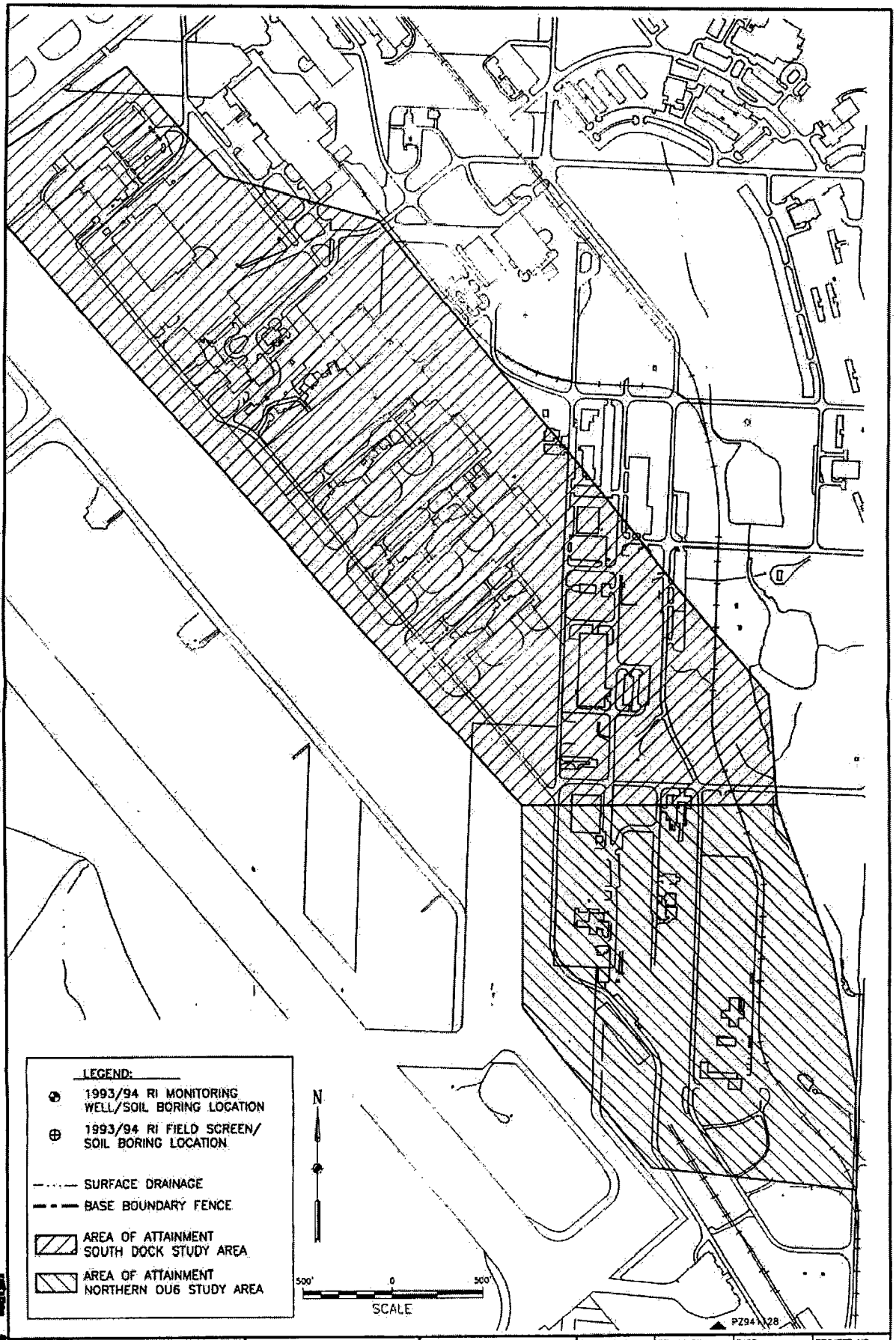


ELLSWORTH AIR FORCE BASE

ELLSWORTH AFB
RAPID CITY, SOUTH DAKOTA

OU-11 RI
SITE LOCATION MAP

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
		STAFF		AS SHOWN	SEP 95	60378.90	3-25



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	AREA 1 AREA OF ATTAINMENT	DESIGNED BY	DRAWN BY	DATE JUNE 95	PROJECT NO. 60378.90
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-26

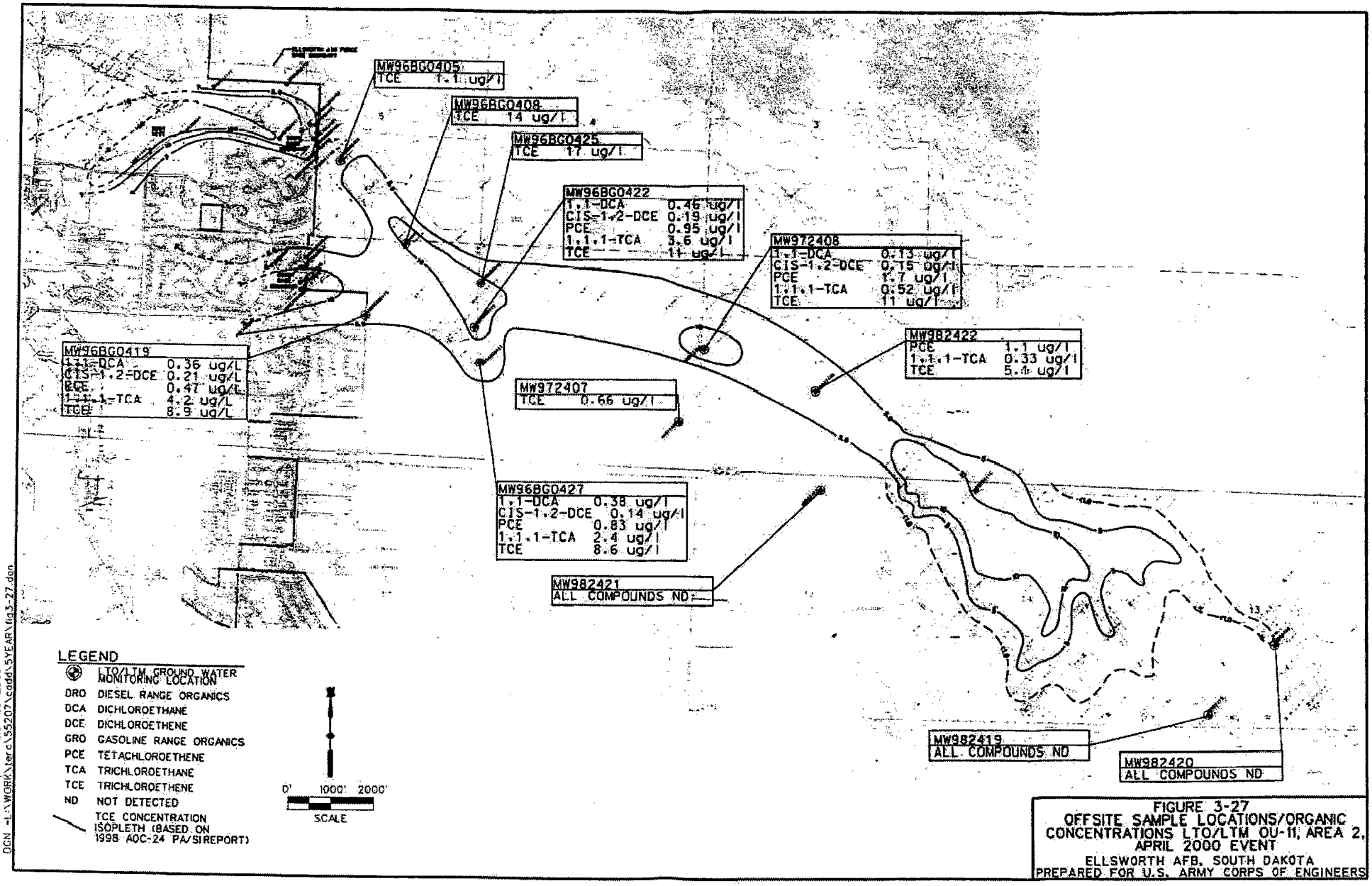
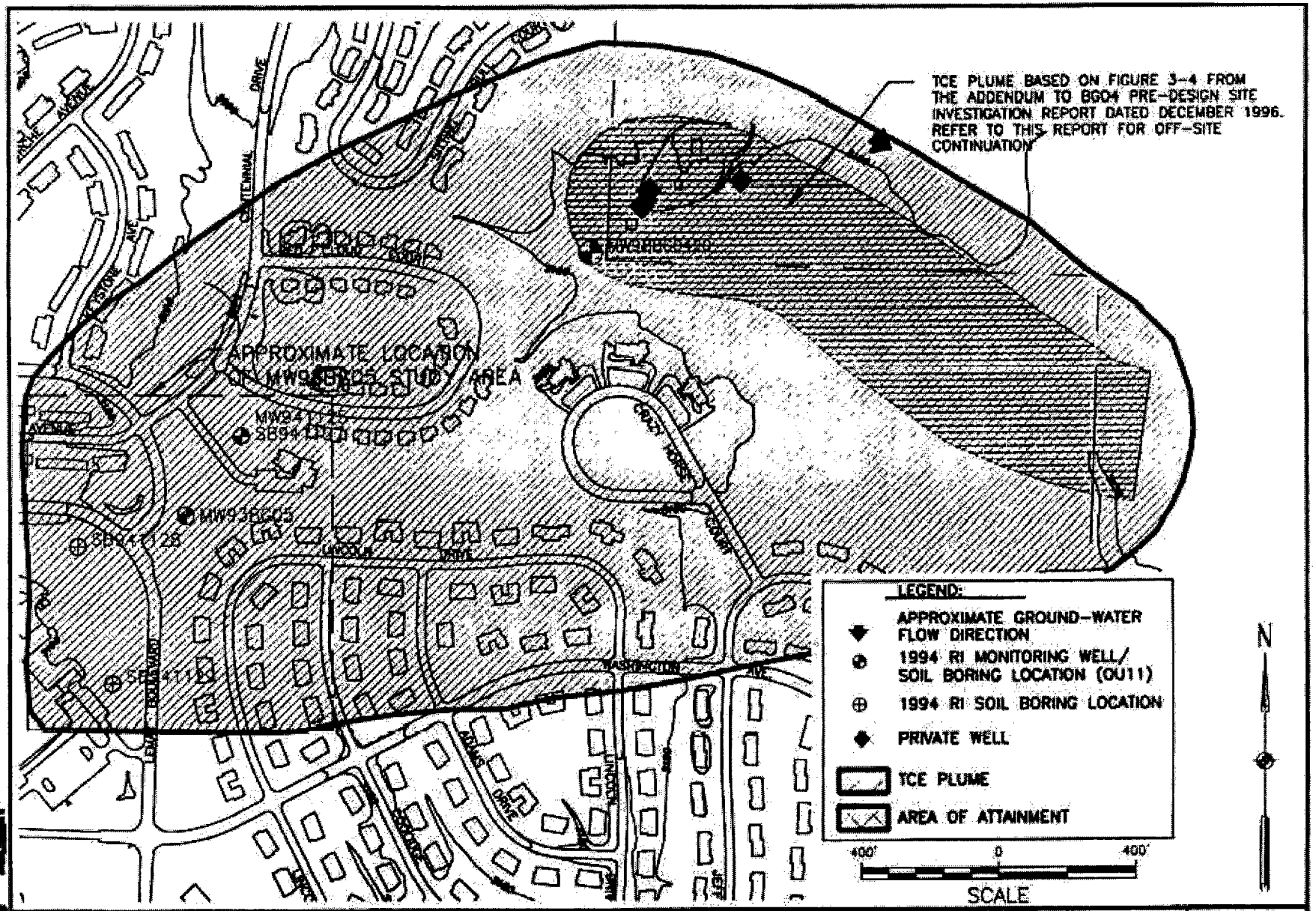
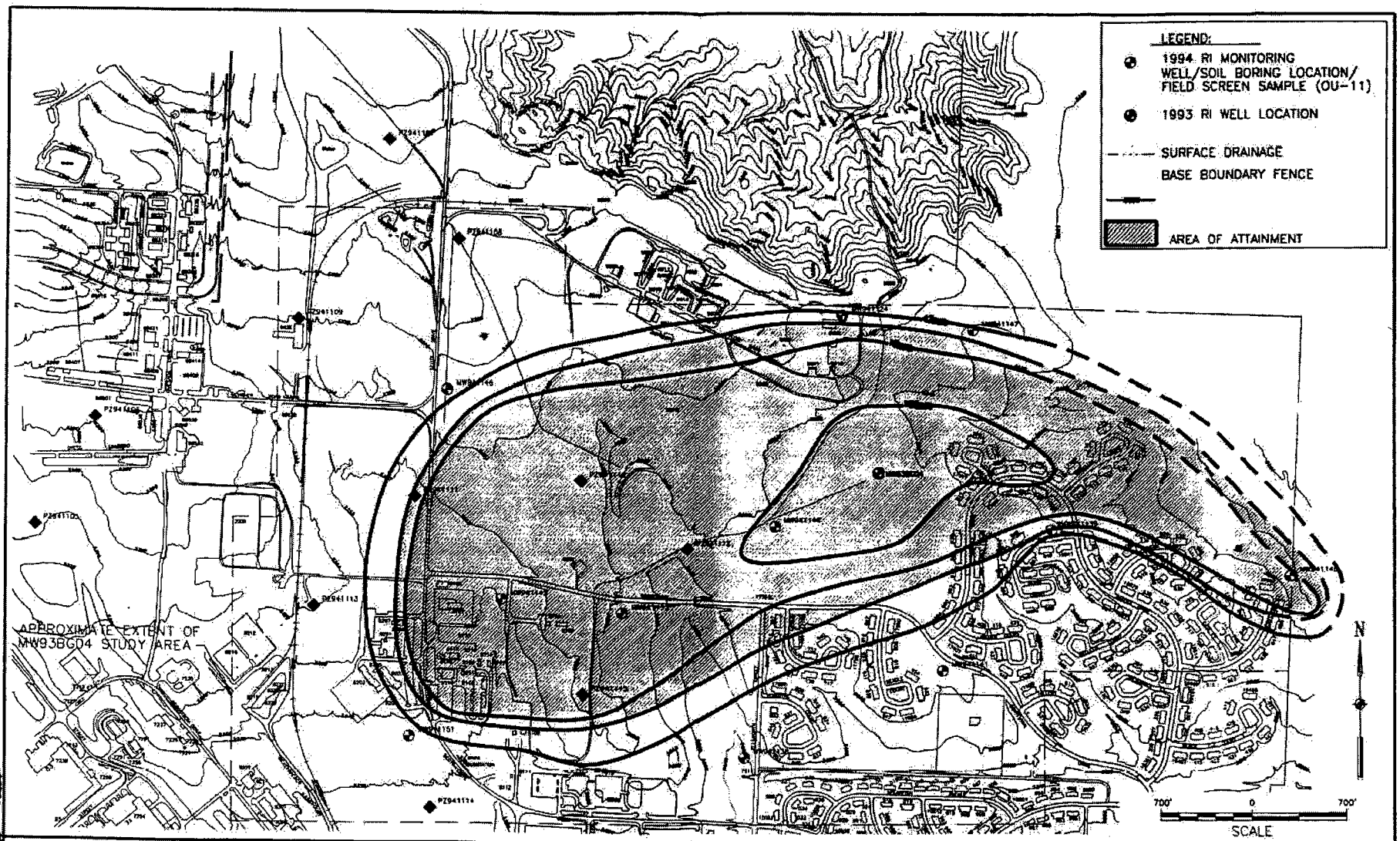


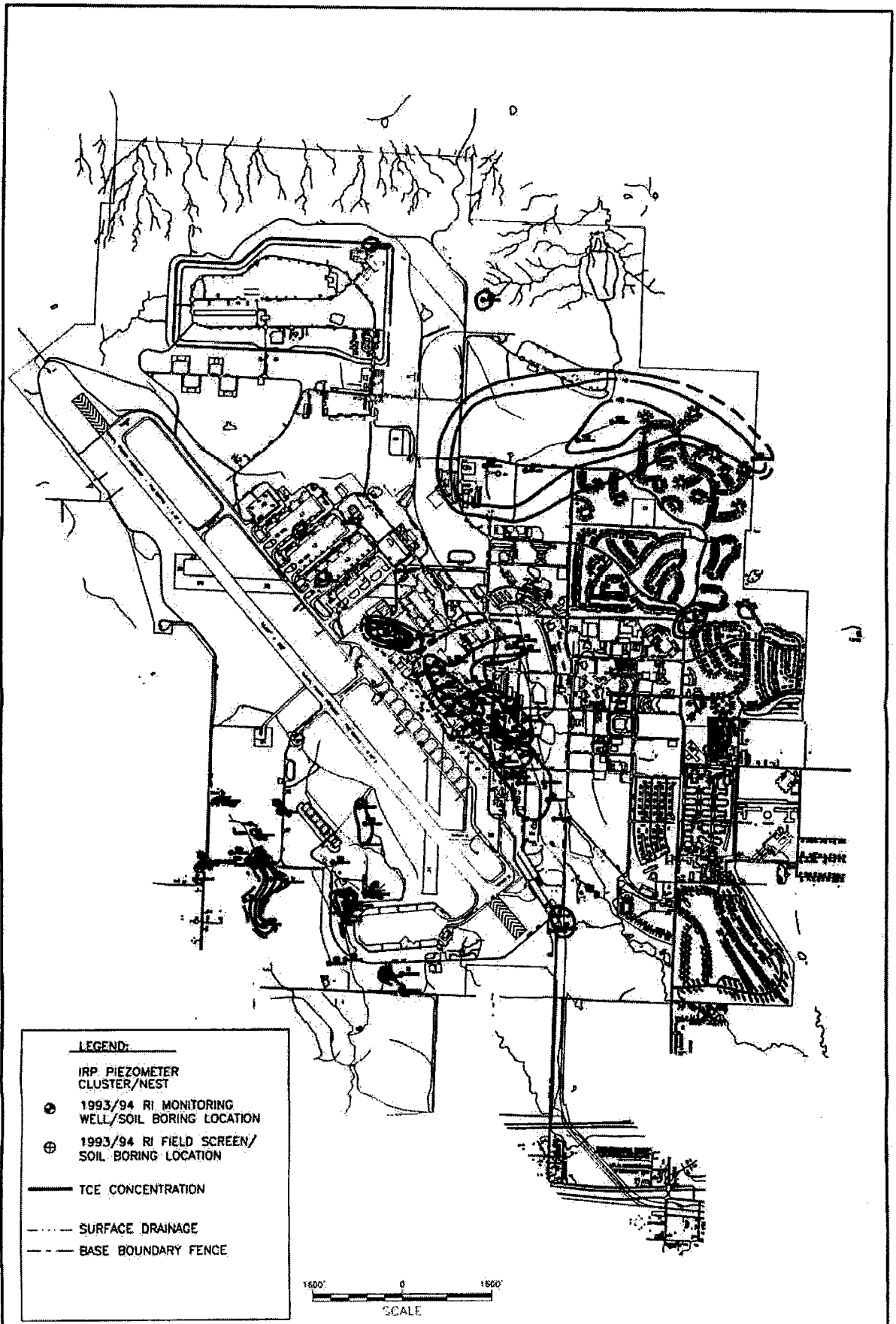
FIGURE 3-27
OFFSITE SAMPLE LOCATIONS/ORGANIC CONCENTRATIONS LTO/LTM OU-11, AREA 2, APRIL 2000 EVENT
ELLSWORTH AFB, SOUTH DAKOTA
PREPARED FOR U.S. ARMY CORPS OF ENGINEERS



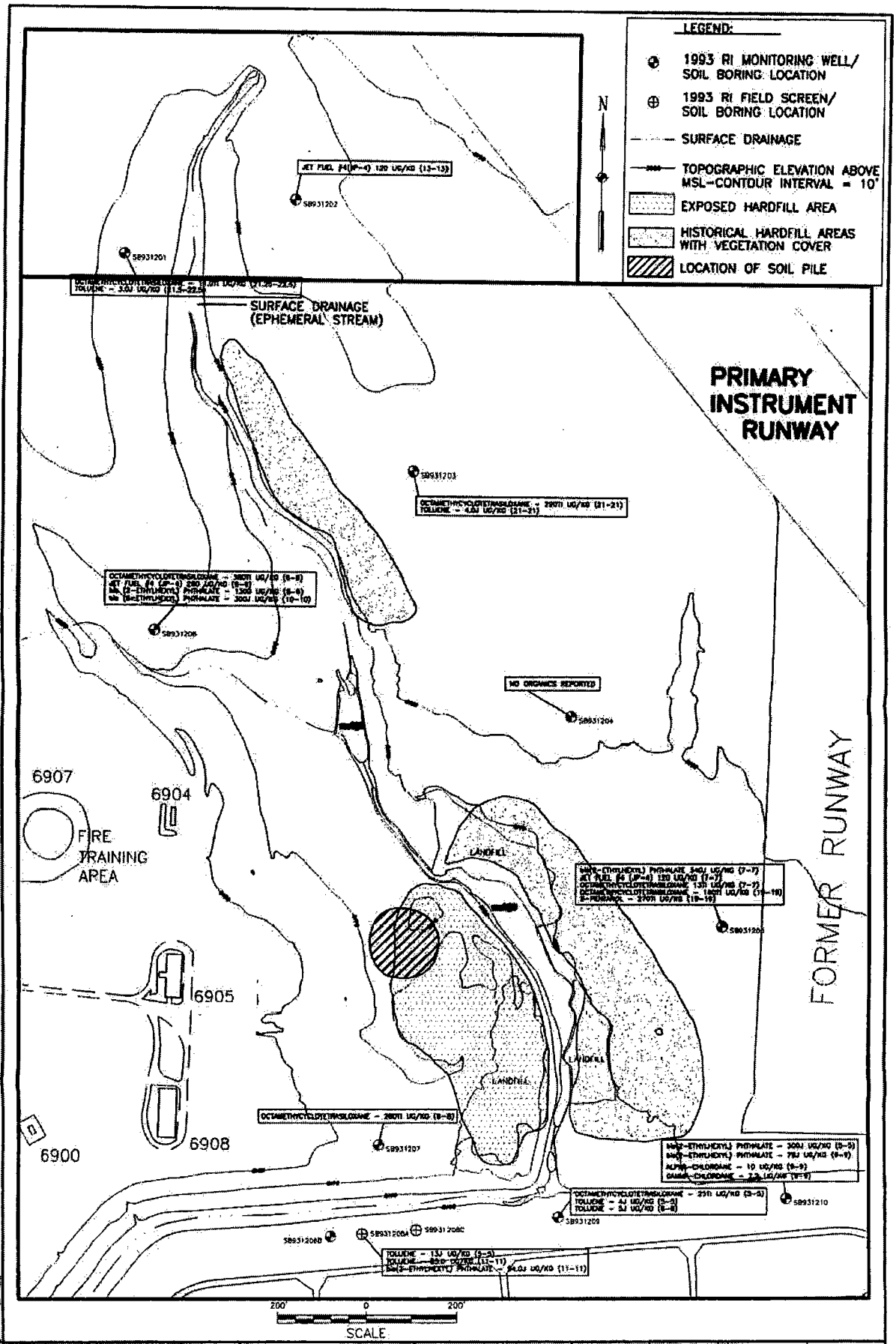
ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB SOUTH DAKOTA	AREA 2 ON-BASE BG05 AREA OF ATTAINMENT OU-11 FS	DESIGNED BY	DRAWN BY	DATE SEP 95	PROJECT NO. 60378.90
			CHECKED BY TMO	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-28



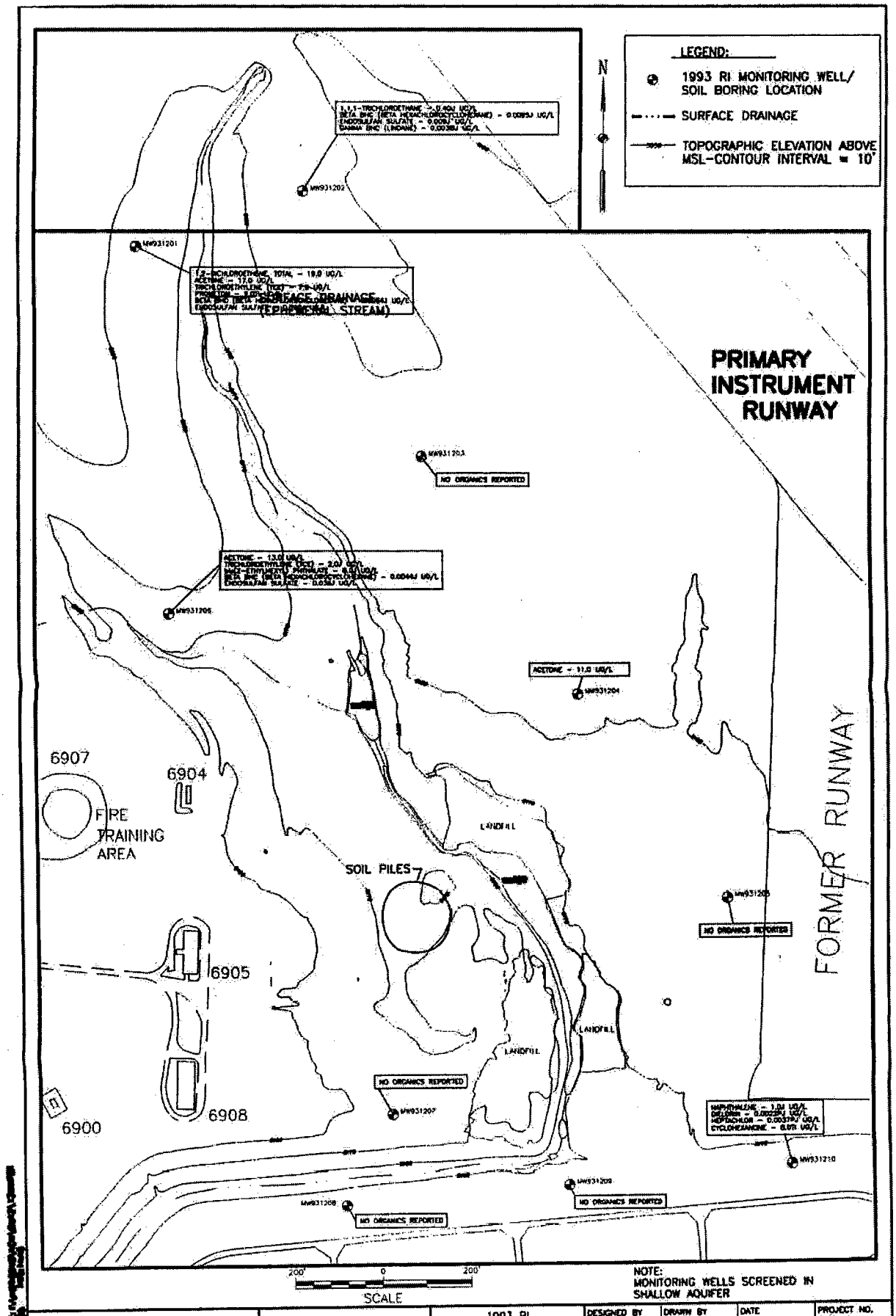
ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB SOUTH DAKOTA	AREA 2 ON-BASE BG04 ON-BASE AREA OF ATTAINMENT OU-11 ROD	DESIGNED BY	DRAWN BY STAFF	DATE SEP 95	PROJECT NO. 60378.90	FILE NAME	
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	DRAWING NO.	FIGURE 3-29	



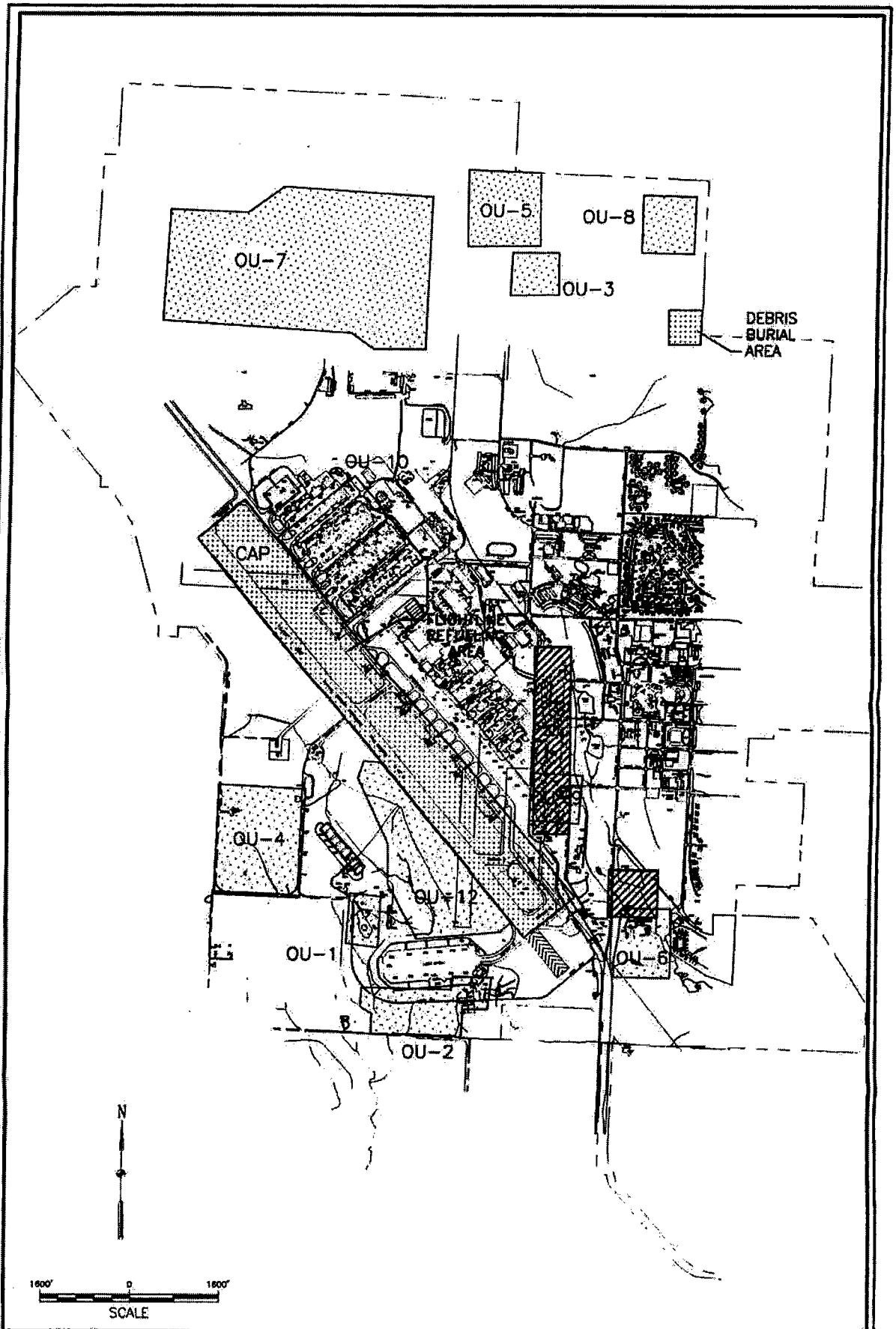
ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	OU-11 ROD DISTRIBUTION OD TCE ON-BASE GROUND WATER	DESIGNED BY	DRAWN BY	DATE JUNE 95	PROJECT NO. 60378.90
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-30



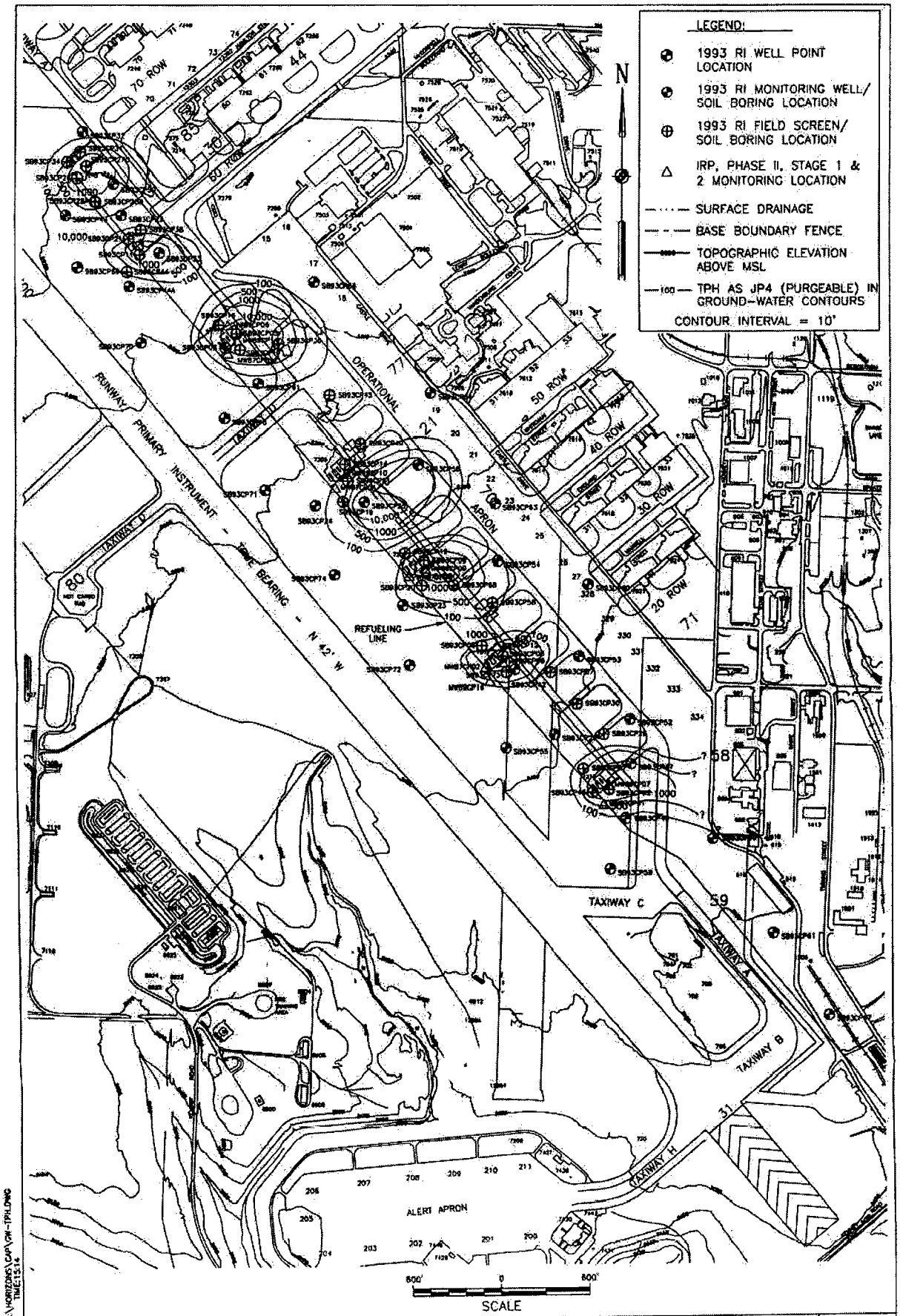
ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	OU-12 REPORTED VOC, SVOC, PESTICIDE/PCB, TPH, SOIL SAMPLES (VALUE W/DEPTH)	DESIGNED BY	DRAWN BY STAFF	DATE MAY 95	PROJECT NO. 60378.85
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-31



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	1993 RI REPORTED VOC, SVOC, PESTICIDE/PCB – MONITORING WELLS OU-12	DESIGNED BY	DRAWN BY STAFF	DATE MAY 95	PROJECT NO. 60378.85
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-32



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	LOCATION MAP OF FLIGHTLINE REFUELING AREA	DESIGNED BY	DRAWN BY STAFF	DATE OCT 94	PROJECT NO. 60378.88
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-33



DRAWING NAME: E:\WORKZONE\CAP\GW-TPHJDWG
DATE:07/20/2000
TIME:15:14

ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	TPH AS JP-4 (purgeable) IN GROUND-WATER (ug/L)	DESIGNED BY	DRAWN BY	DATE DEC 94	PROJECT NO. 60378.88
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 3-34

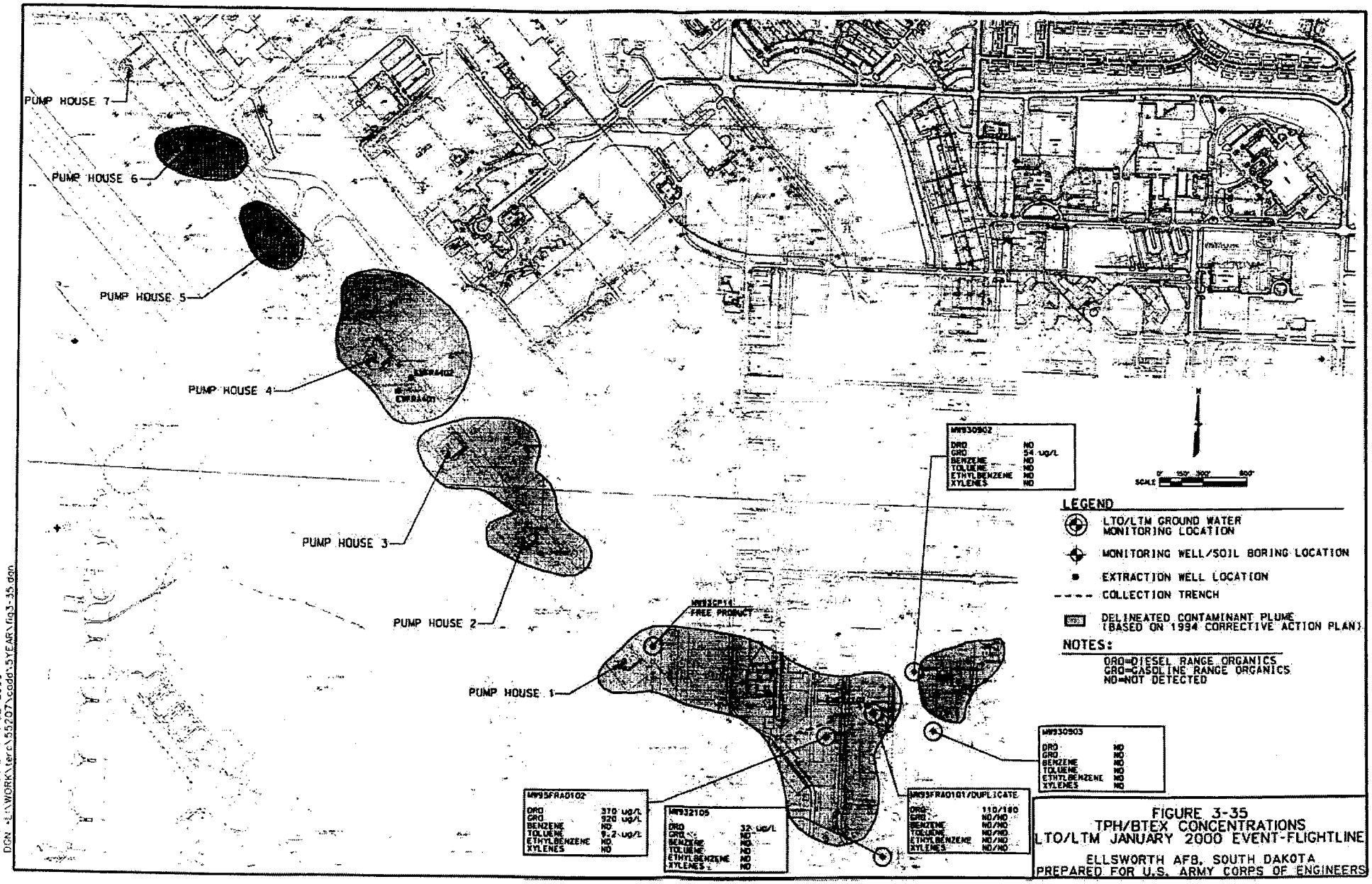
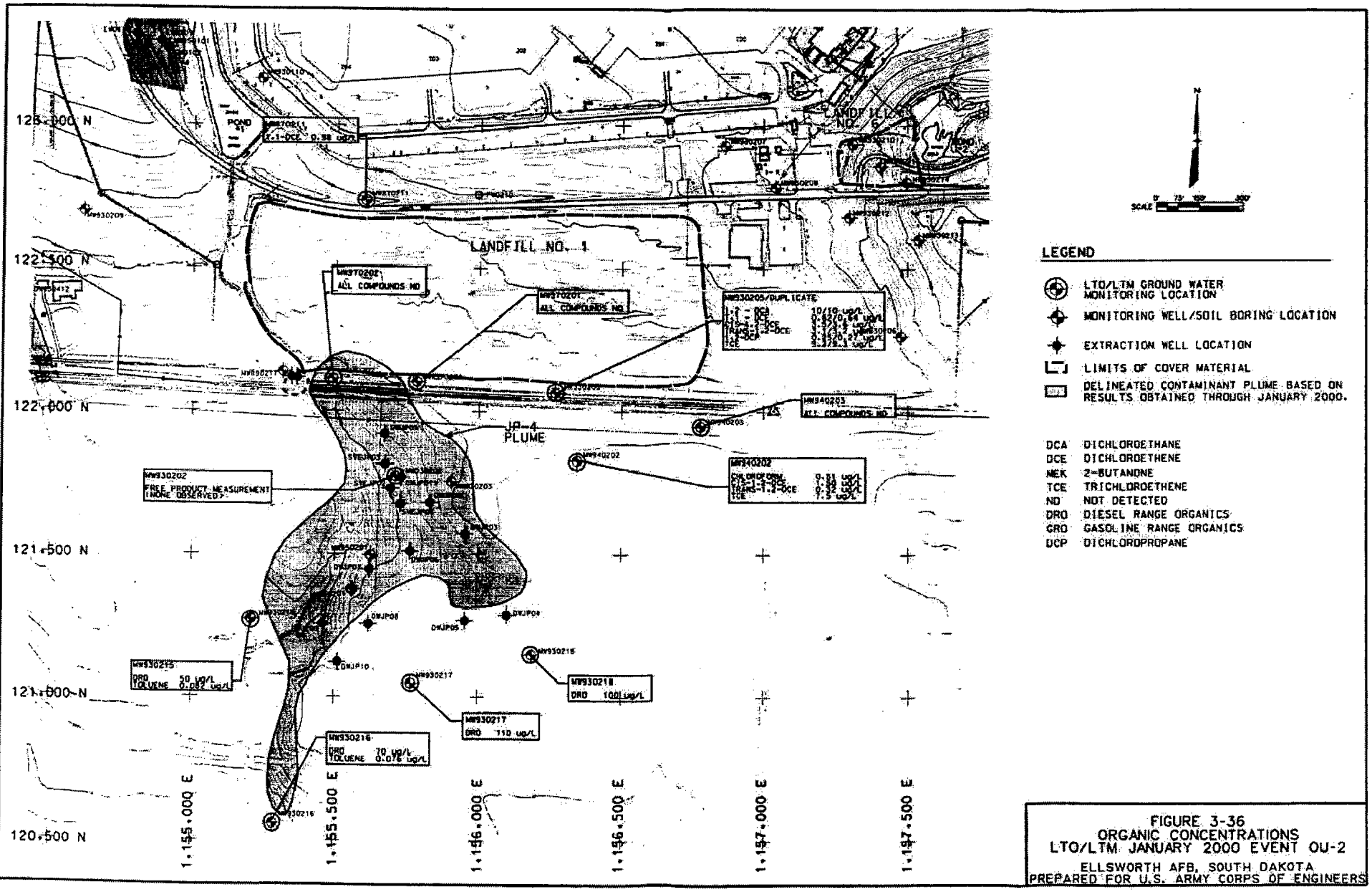


FIGURE 3-35
TPH/BTEX CONCENTRATIONS
LTO/LTM JANUARY 2000 EVENT-FLIGHTLINE

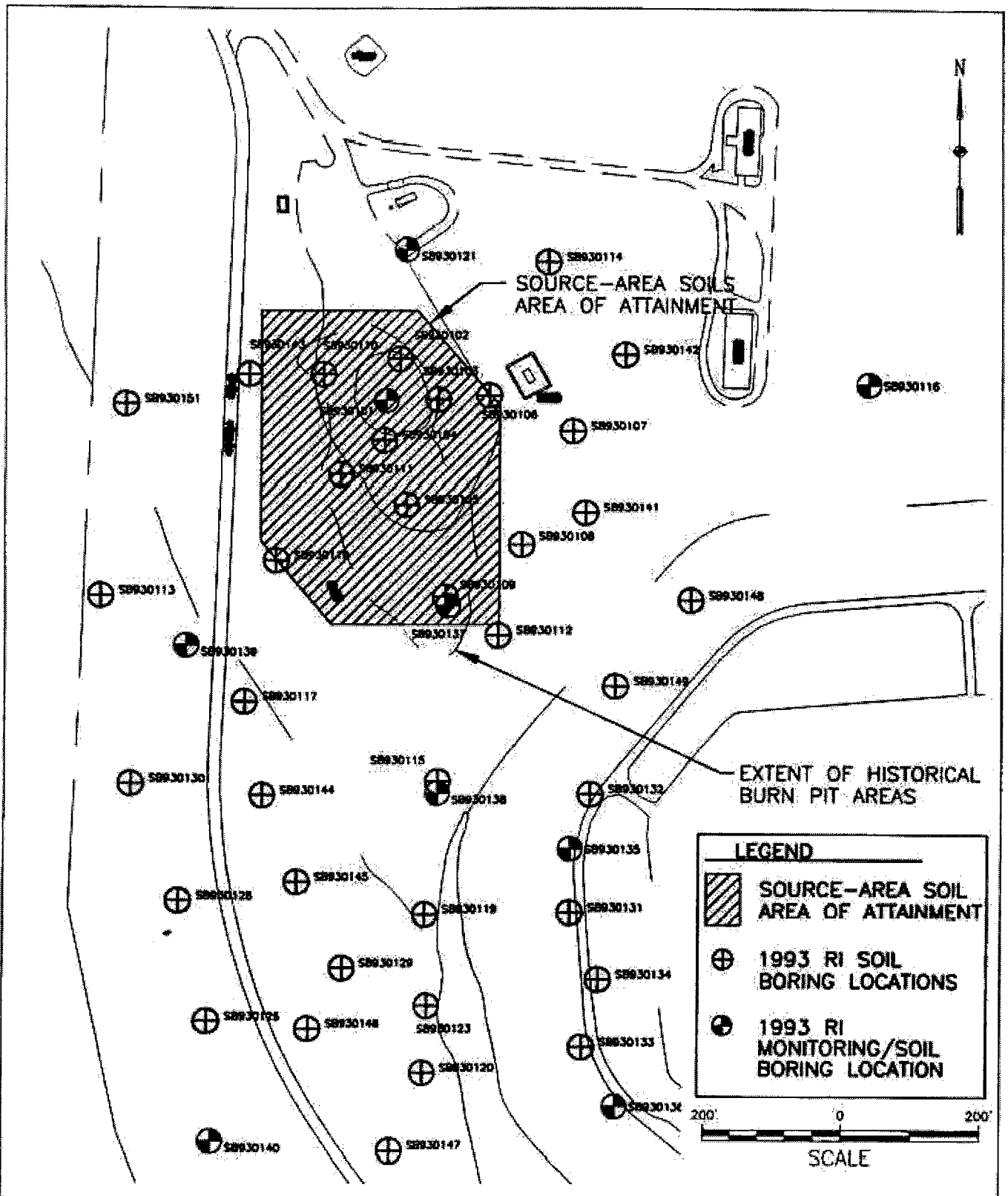
ELLSWORTH AFB, SOUTH DAKOTA
PREPARED FOR U.S. ARMY CORPS OF ENGINEERS

DATE -Wed Jun 21 11:45:12 2000
DGN =E:\WORK\terc\55207\cadd\5YEAR\fig3-35.dgn

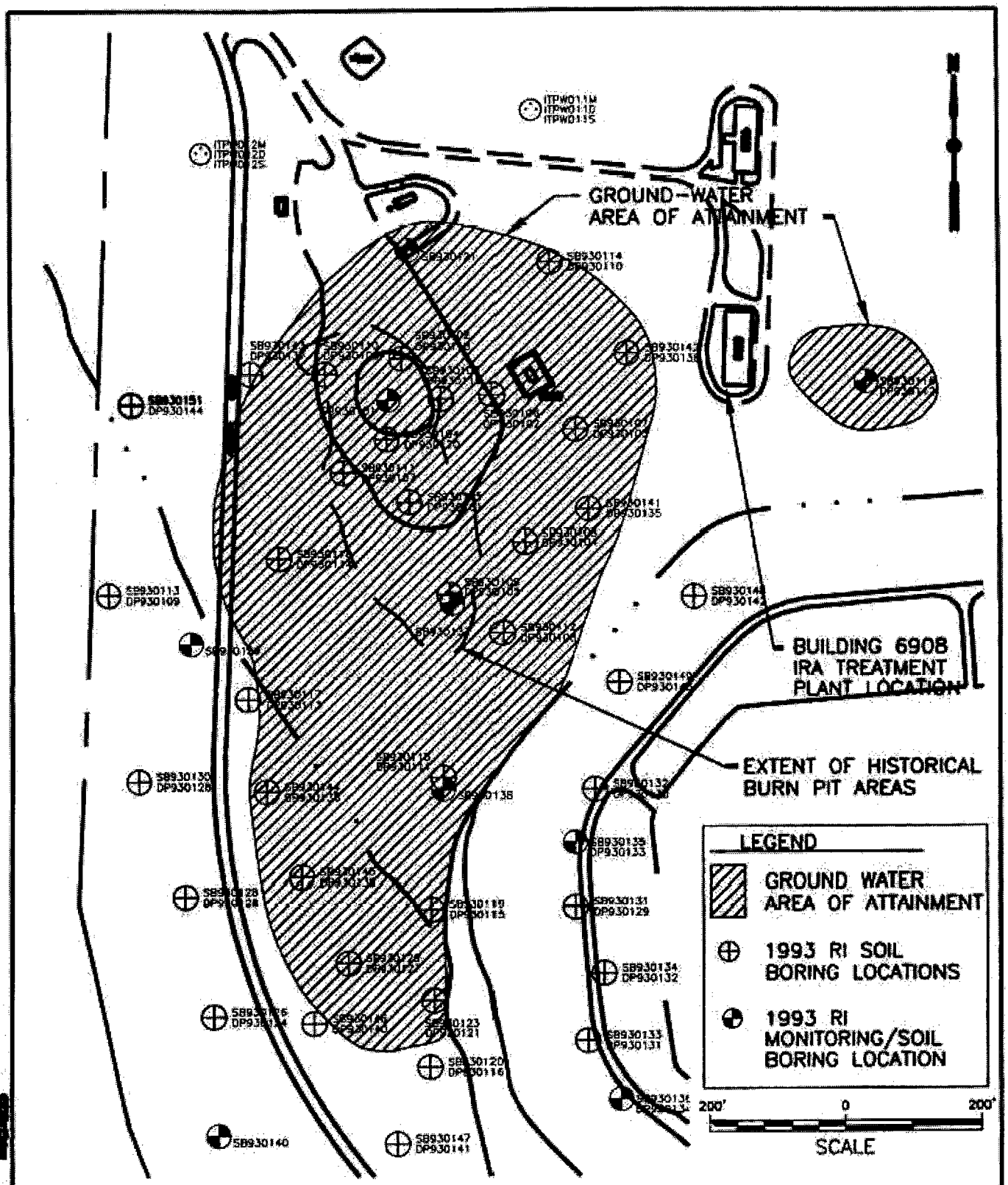


DATE -Wed Jun 21 11:51:43 2000
DGN -I:\work\terp\55207\cadd\5year\fig3-35.dgn

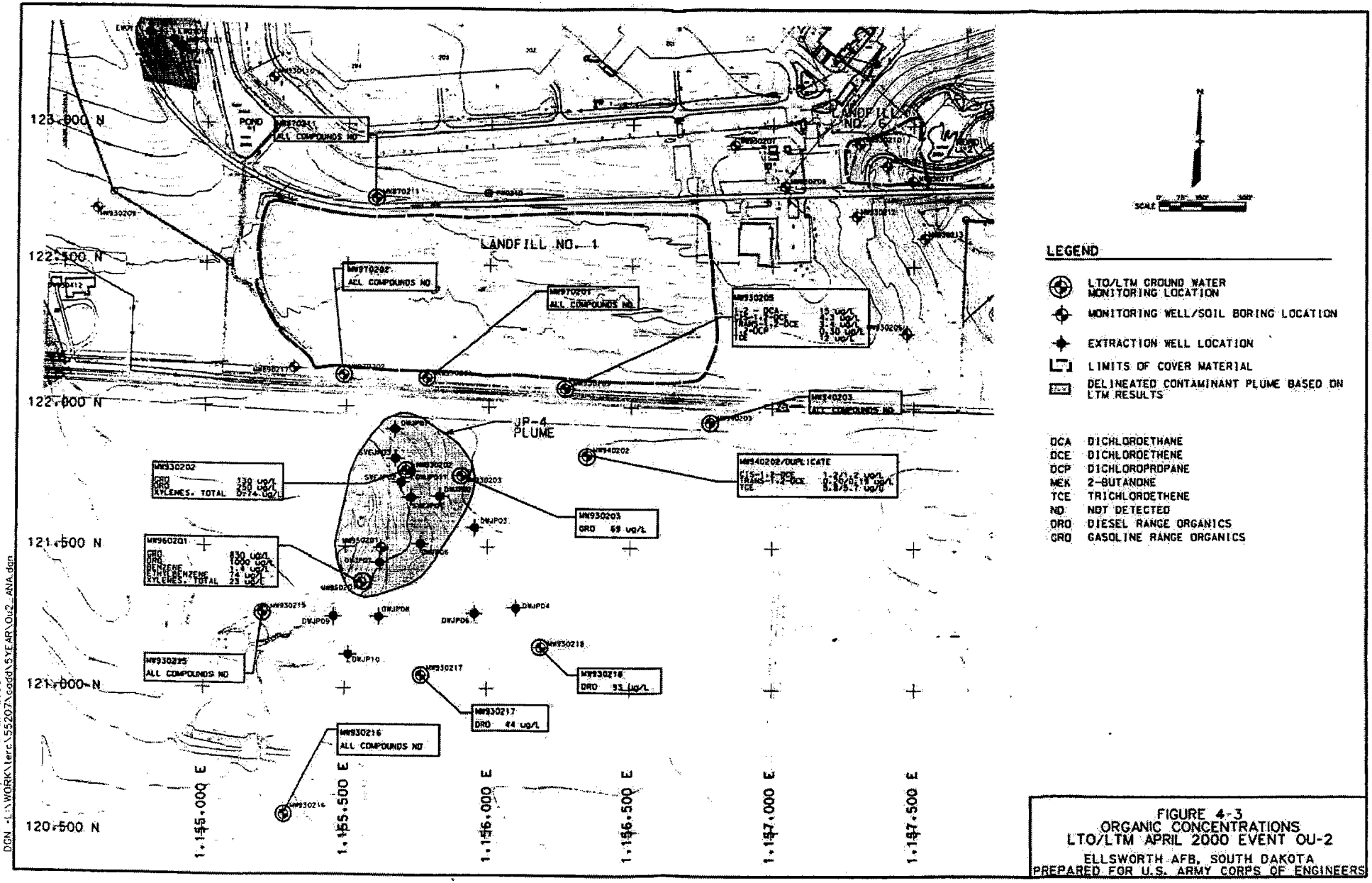
FIGURE 3-36
ORGANIC CONCENTRATIONS
LTO/LTM JANUARY 2000 EVENT OU-2
ELLSWORTH AFB, SOUTH DAKOTA
PREPARED FOR U.S. ARMY CORPS OF ENGINEERS



ELLSWORTH AIR FORCE BASE	TITLE: AREA OF ATTAINMENT FOR SOURCE-AREA SOILS	FIGURE: 4-1	DWN BY: STAFF	APP'D: TR
			DATE: MAR 96	PJT NO: 60378.84



ELLSWORTH AIR FORCE BASE	TITLE: AREA OF ATTAINMENT FOR GROUND WATER	FIGURE: 4-2	DWN BY: STAFF	APP'D: TR
			DATE: MAR 95	PJT NO: 60378.84



DATE = 11Sep 13:27:28 2000
DGN = L:\WORK\1erc\55207\cadd\5YEAR\Ou2_ANA.dgn

FIGURE 4-3
ORGANIC CONCENTRATIONS
LTO/LTM APRIL 2000 EVENT OU-2
ELLSWORTH AFB, SOUTH DAKOTA
PREPARED FOR U.S. ARMY CORPS OF ENGINEERS

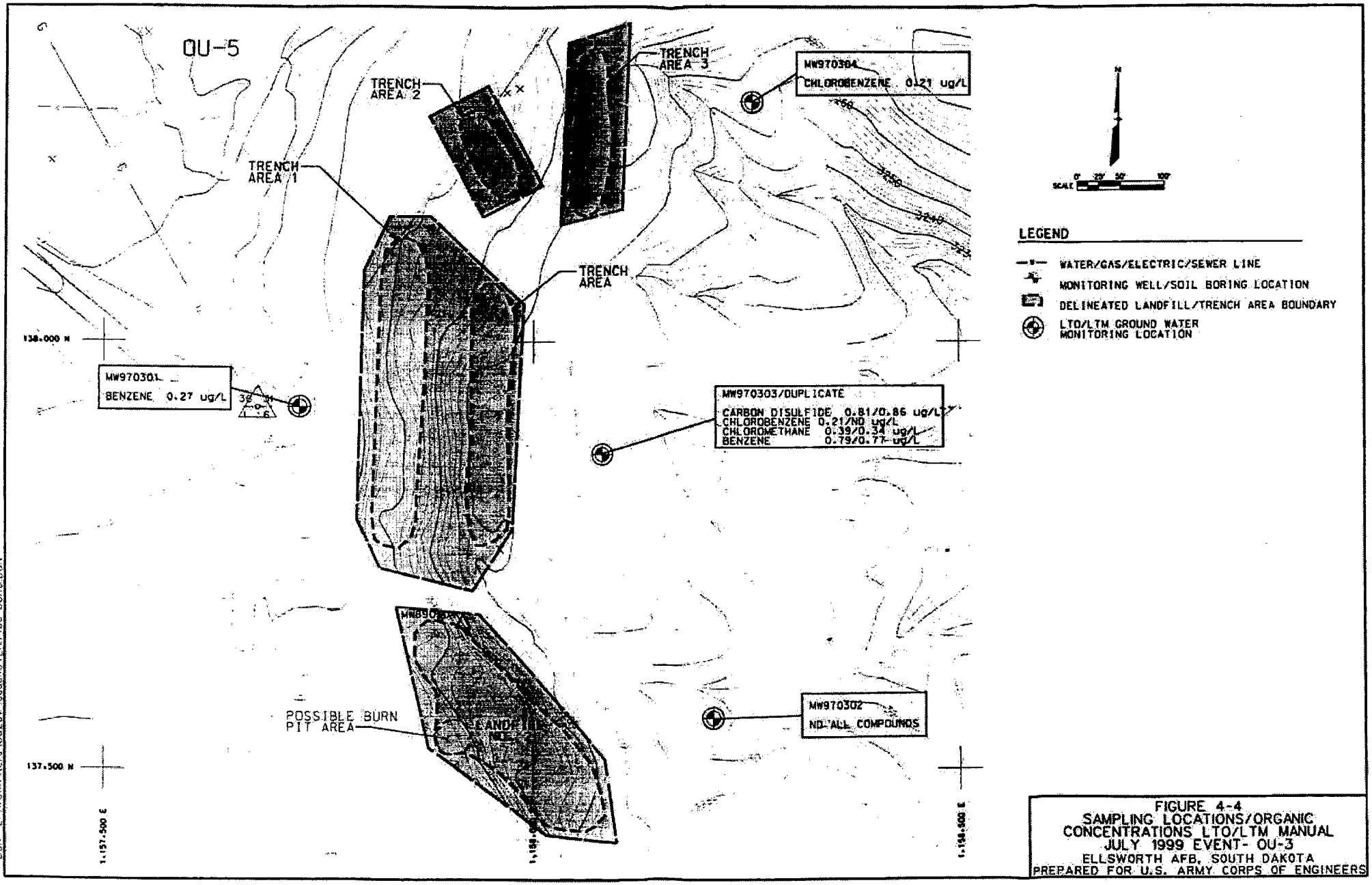


FIGURE 4-4
SAMPLING LOCATIONS/ORGANIC CONCENTRATIONS LTO/LTM MANUAL
JULY 1999 EVENT- OU-3
ELLSWORTH AFB, SOUTH DAKOTA
PREPARED FOR U.S. ARMY CORPS OF ENGINEERS

DATE -Fri Sep 1 13:39:06 2000
DGN -L:\WORK\terc\55207\cadd\SYEAR\OU-3ORG.DGN

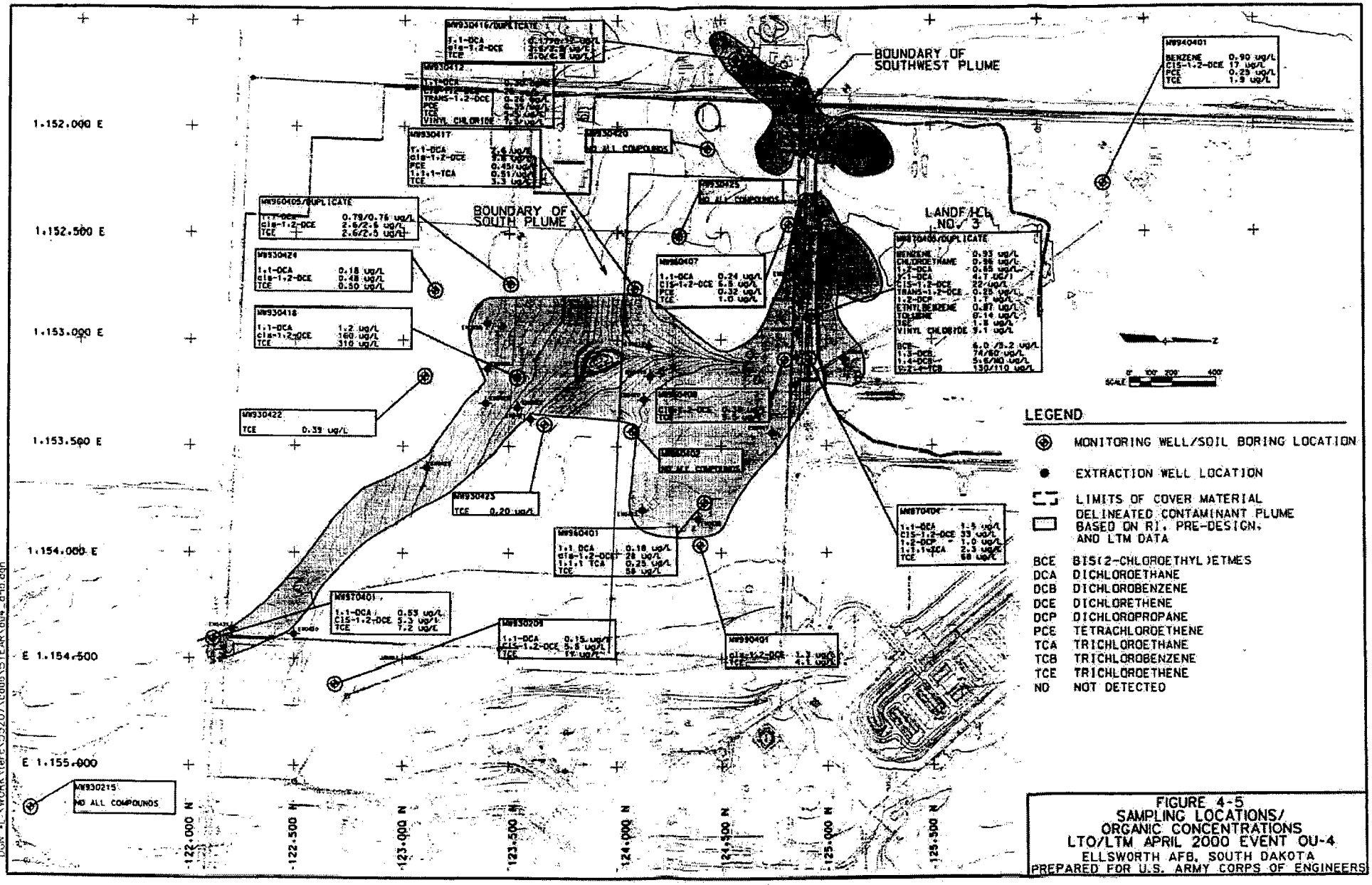
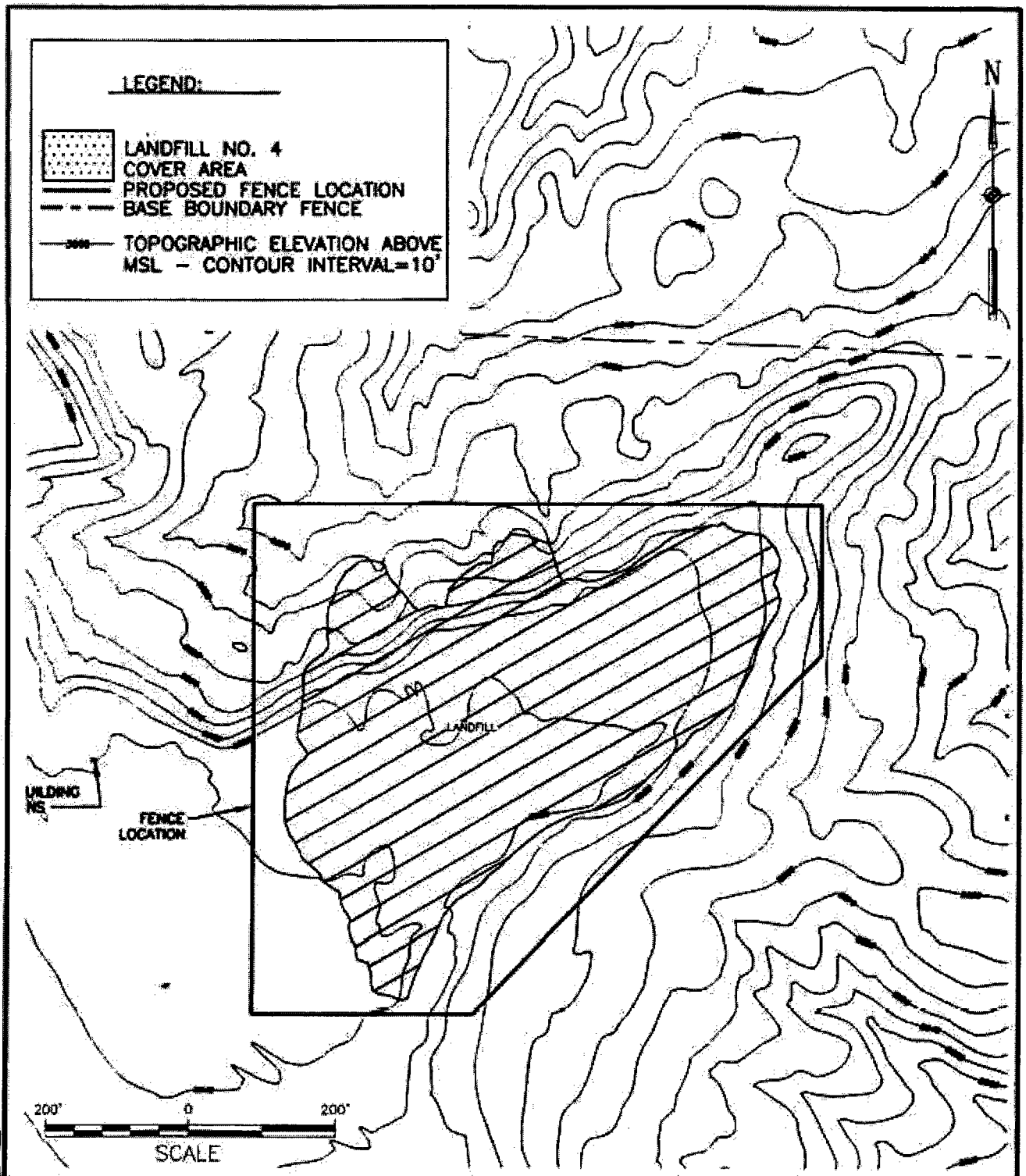


FIGURE 4-5
SAMPLING LOCATIONS/
ORGANIC CONCENTRATIONS
LTO/LTM APRIL 2000 EVENT OU-4
ELLSWORTH AFB, SOUTH DAKOTA
PREPARED FOR U.S. ARMY CORPS OF ENGINEERS



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	OPERABLE UNIT 5 LANDFILL NO. 4

DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
	STAFF		AS SHOWN	SEP 95	60378.93	4-6

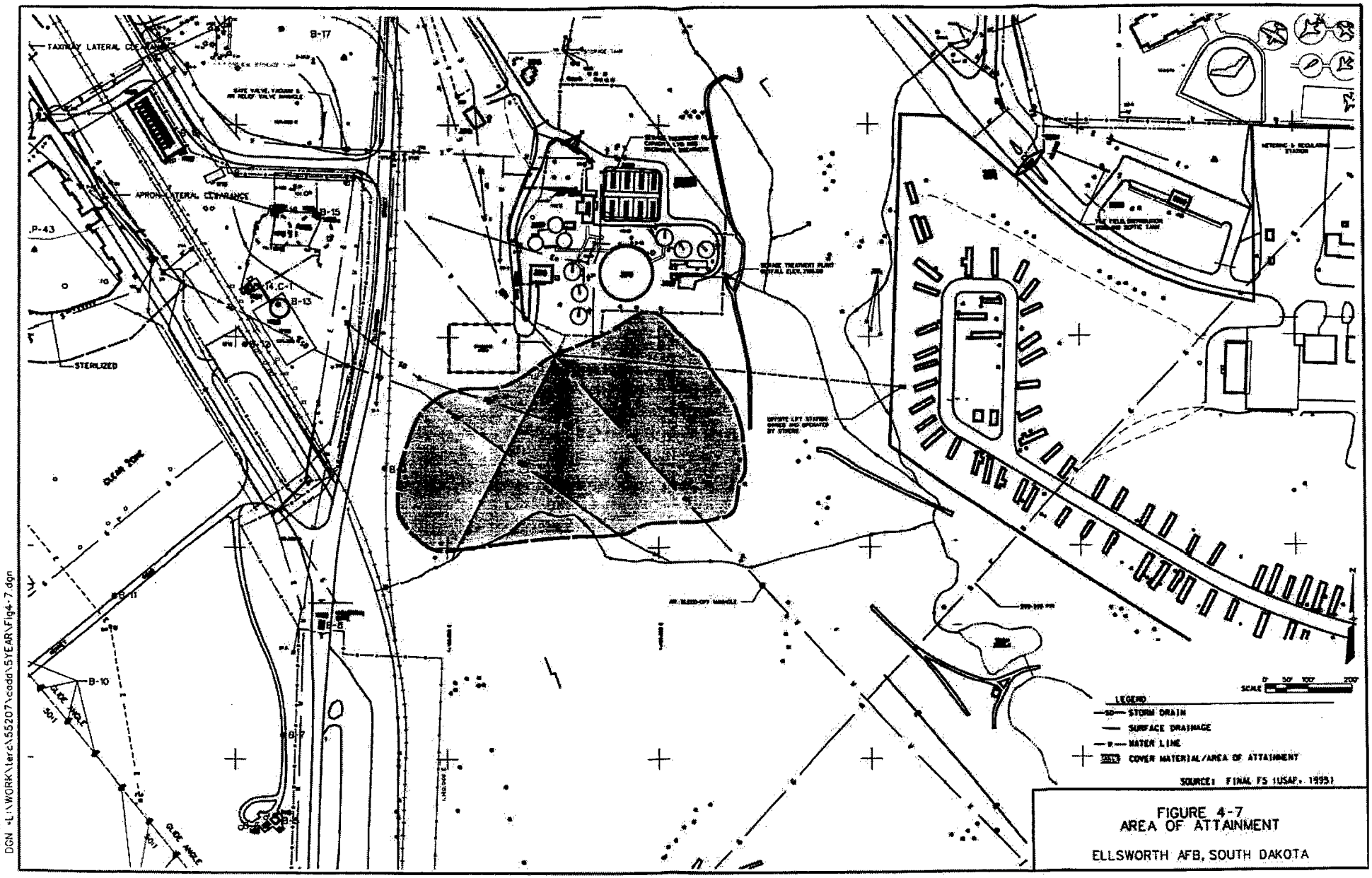
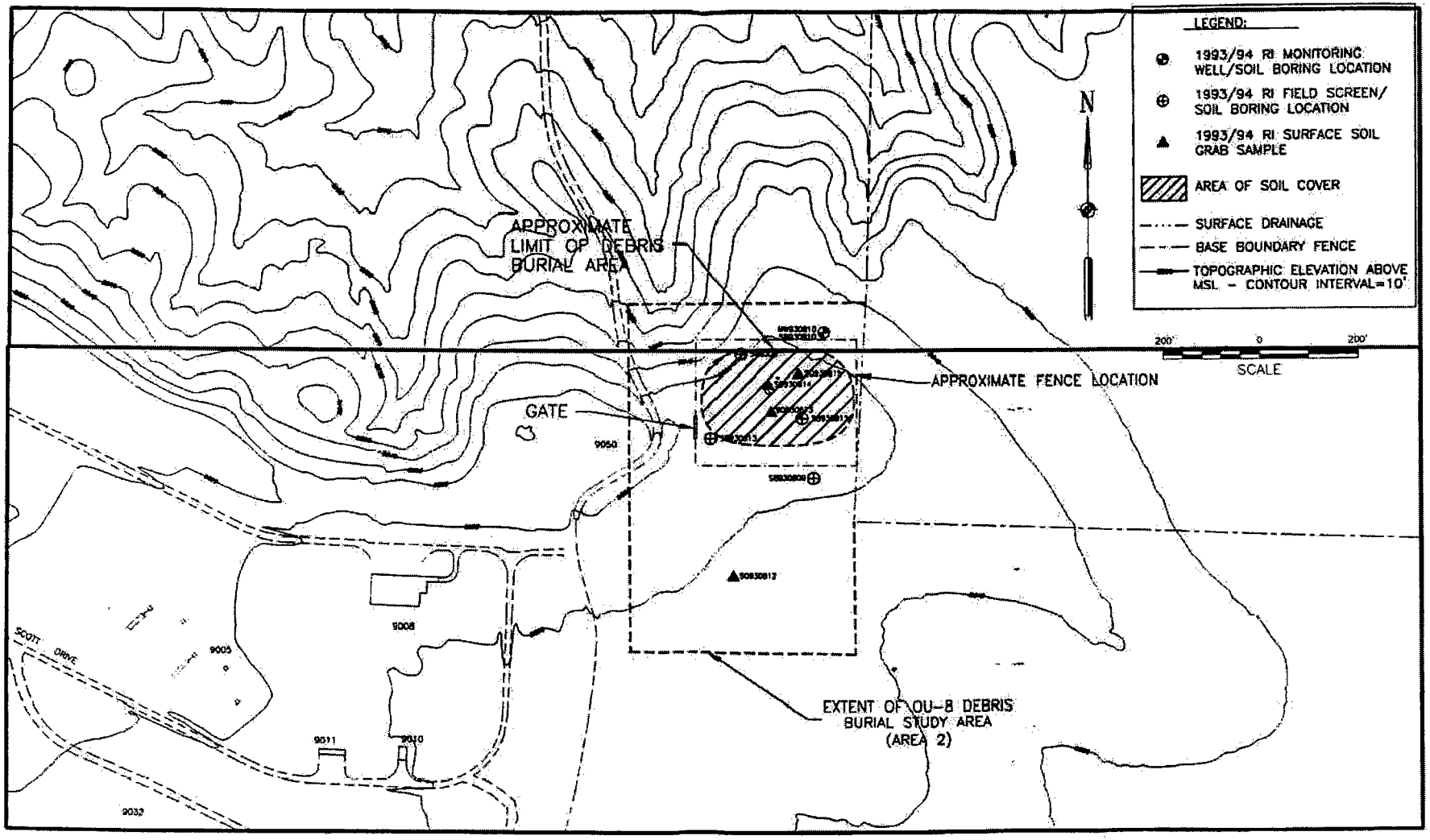


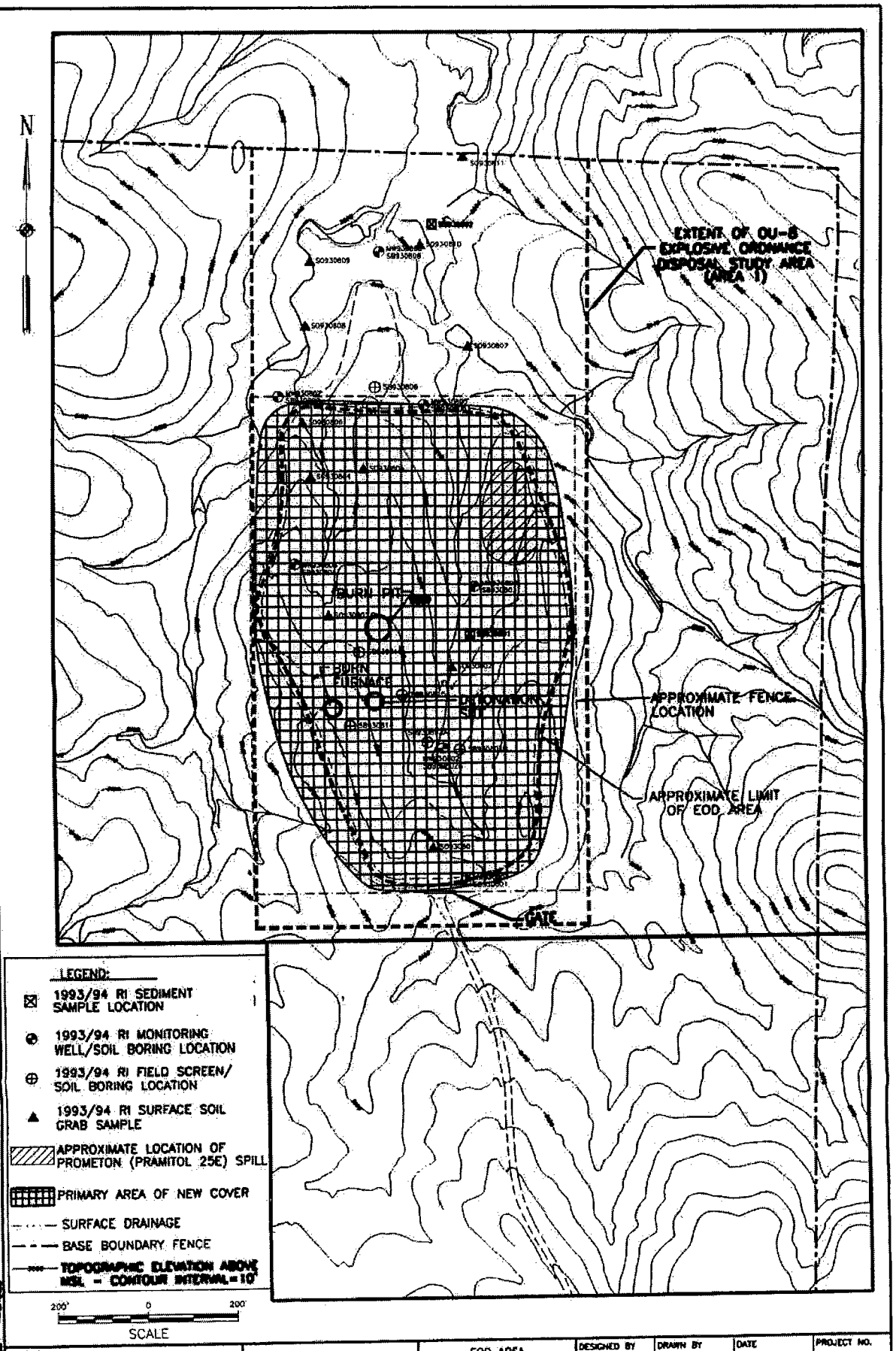
FIGURE 4-7
AREA OF ATTAINMENT

ELLSWORTH AFB, SOUTH DAKOTA

$SDATE -$S
DGN -L:\WORK\ter\55207\cadd\5YEAR\Fig4-7.dgn



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB SOUTH DAKOTA	DEBRIS BURIAL AREA ALTERNATIVE NO. 3 SOIL REMOVAL VEGETATIVE COVER/ INSTITUTIONAL CONTROLS	DESIGNED BY	DRAWN BY JSS	DATE FEB 96	PROJECT NO.	FILE NAME
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	DRAWING NO.	FIGURE 4-8



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	EOD AREA ALTERNATIVE NO. 3 VEGETATIVE COVER/ INSTITUTIONAL CONTROLS	DESIGNED BY	DRAWN BY JSS	DATE JAN 96	PROJECT NO.
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 4-9

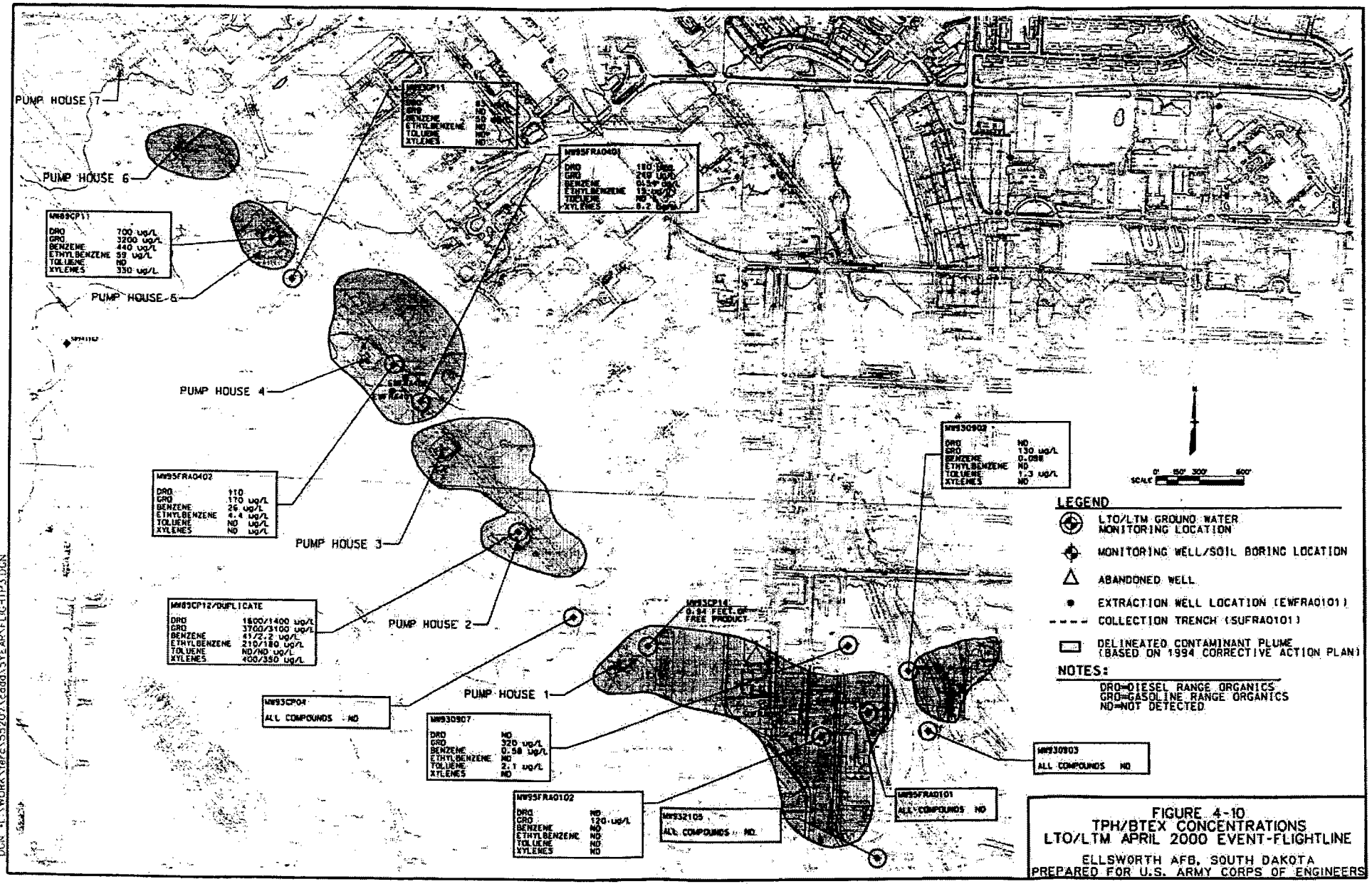
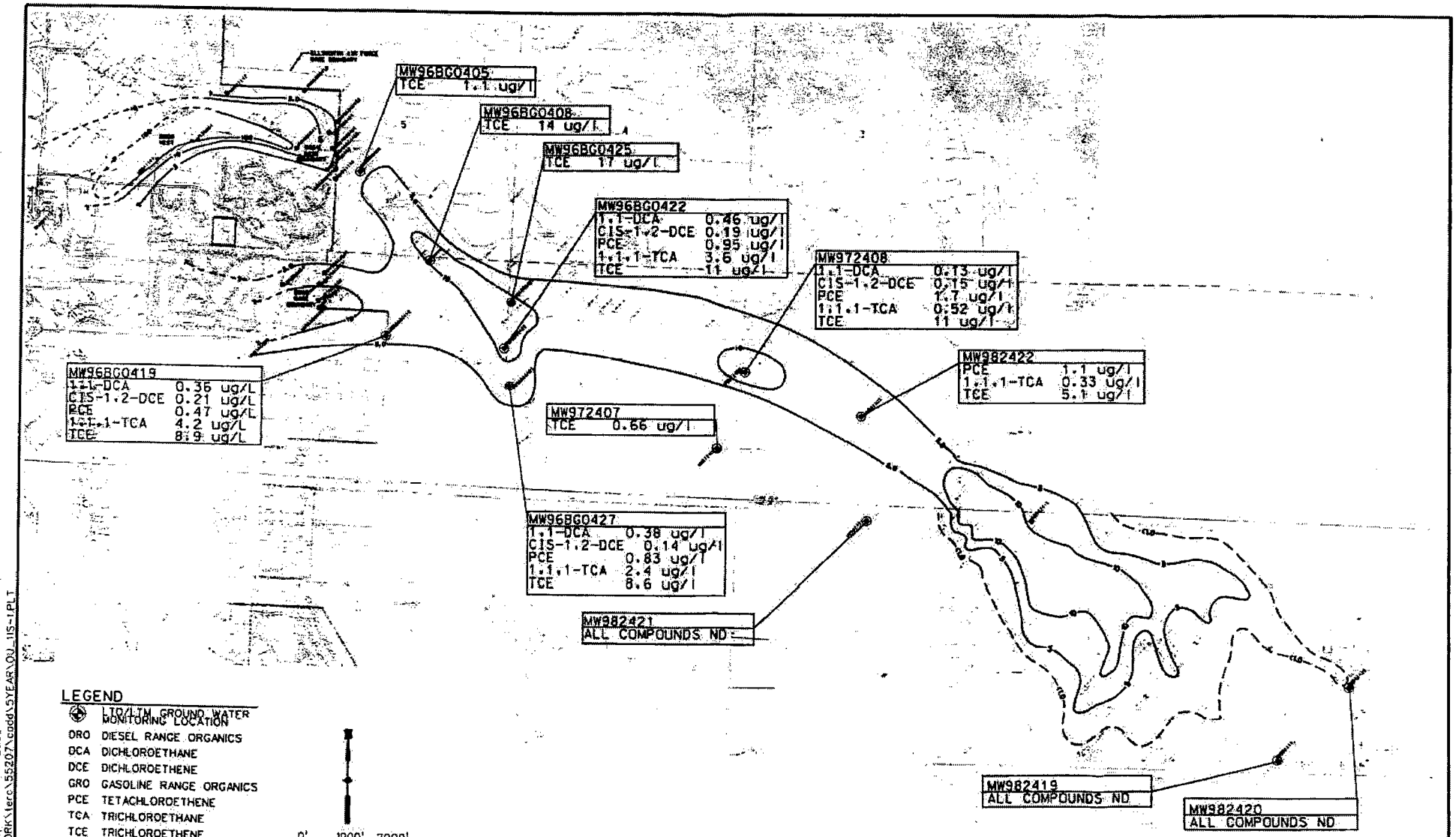


FIGURE 4-10
TPH/BTEX CONCENTRATIONS
LTO/LTM APRIL 2000 EVENT-FLIGHTLINE

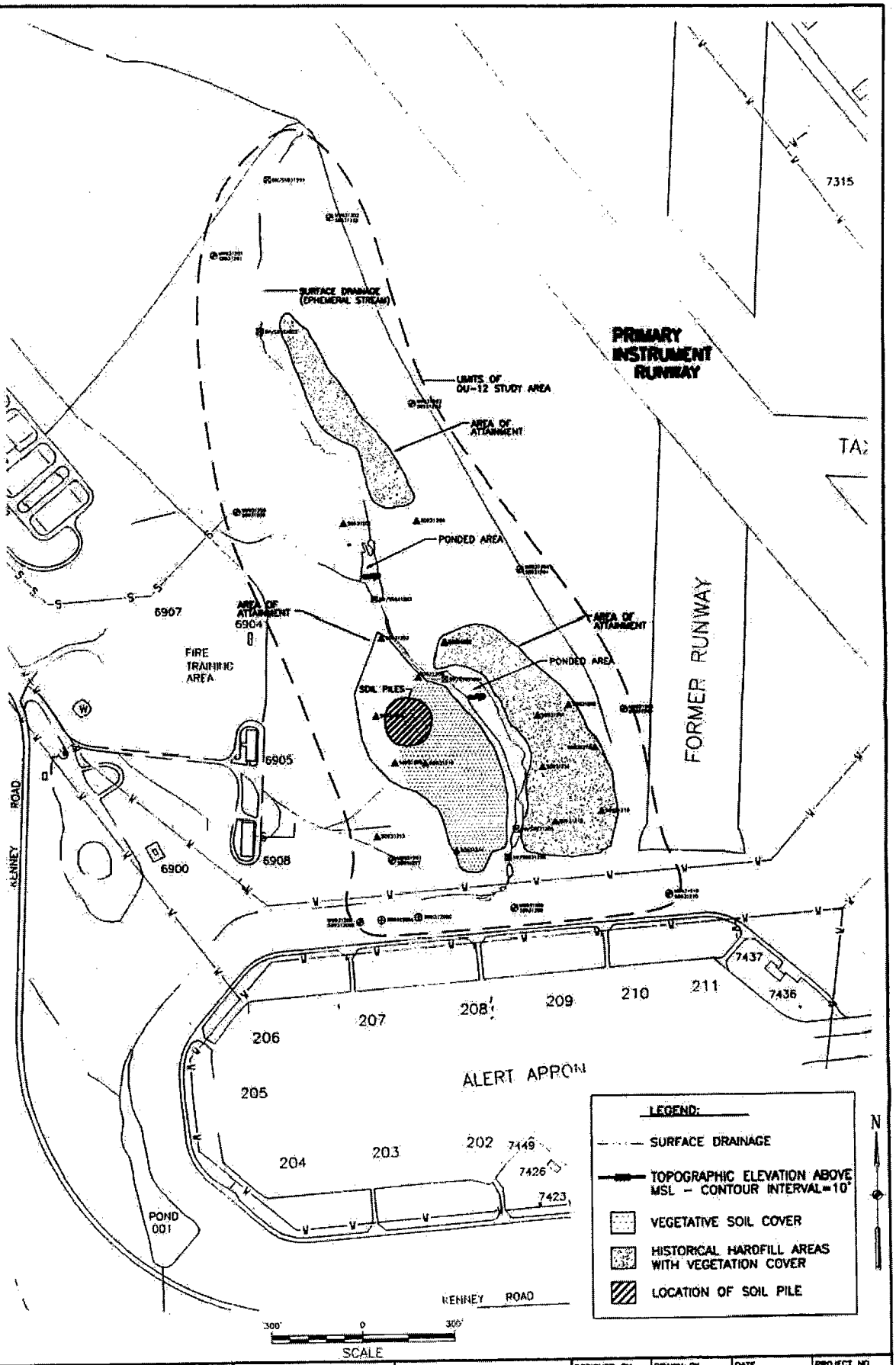
ELLSWORTH AFB, SOUTH DAKOTA
PREPARED FOR U.S. ARMY CORPS OF ENGINEERS

DATE 4-FIISep 11:35:36 2000
DGN L:\WORK\ferc\55207\cadd\SYEAR\FLIG-HTP3.DGN



DATE = Fri Sep 1 13:36:51 2000
DGN = L:\WORK\1ecc\55207\cadd\5YEAR\OU_11S-1.PLT

FIGURE 4-11
OFFSITE SAMPLE LOCATIONS/ORGANIC CONCENTRATIONS LTO/LTM OU-11, AREA 2, APRIL 2000 EVENT
ELLSWORTH AFB, SOUTH DAKOTA
PREPARED FOR U.S. ARMY CORPS OF ENGINEERS



ELLSWORTH AIR FORCE BASE	ELLSWORTH AFB RAPID CITY, SOUTH DAKOTA	OU-12 AREA OF ATTAINMENT	DESIGNED BY	DRAWN BY STAFF	DATE JULY 95	PROJECT NO. 60378.85
			CHECKED BY	PROJECT MGR.	SCALE AS SHOWN	FIGURE 4-12

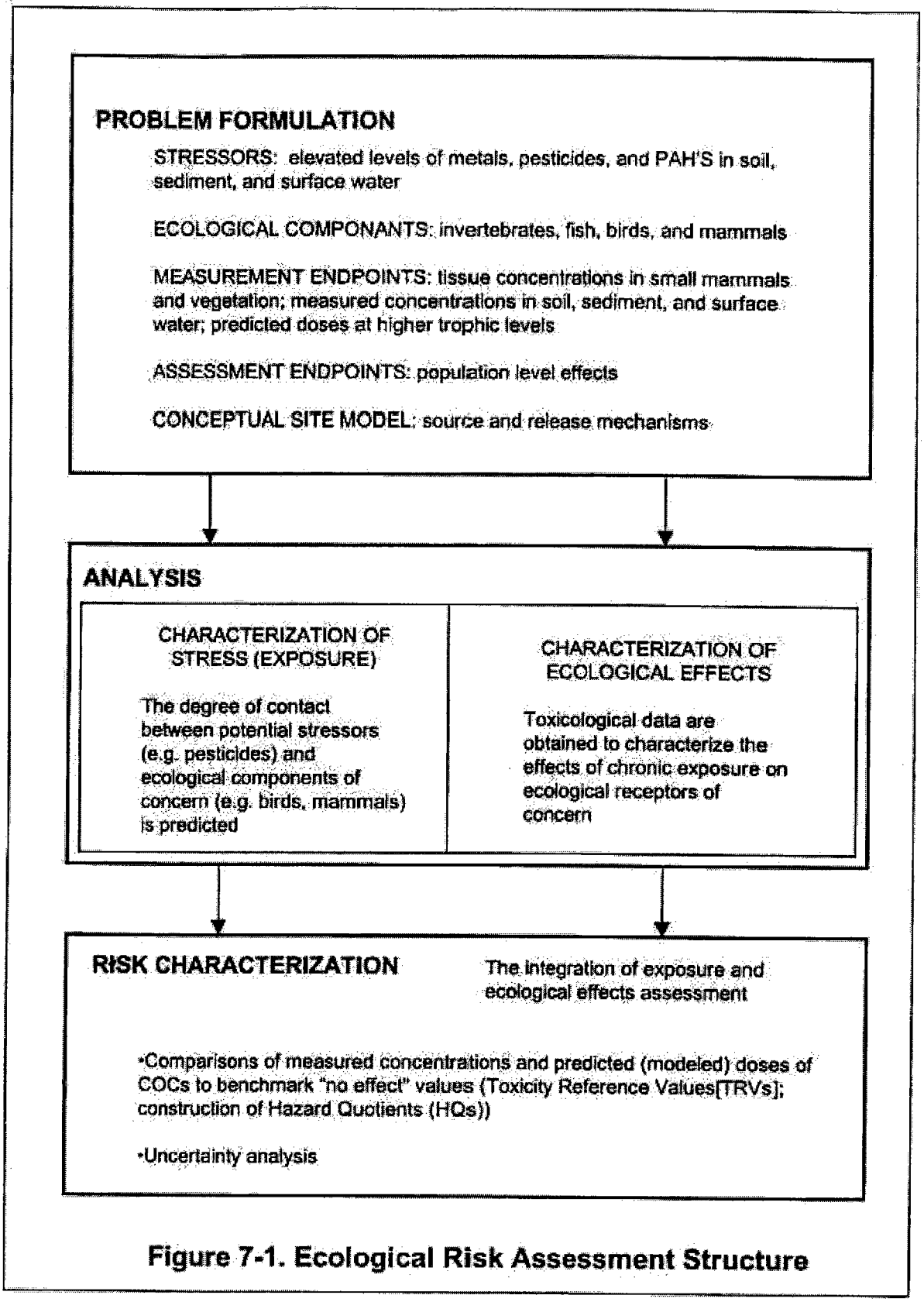
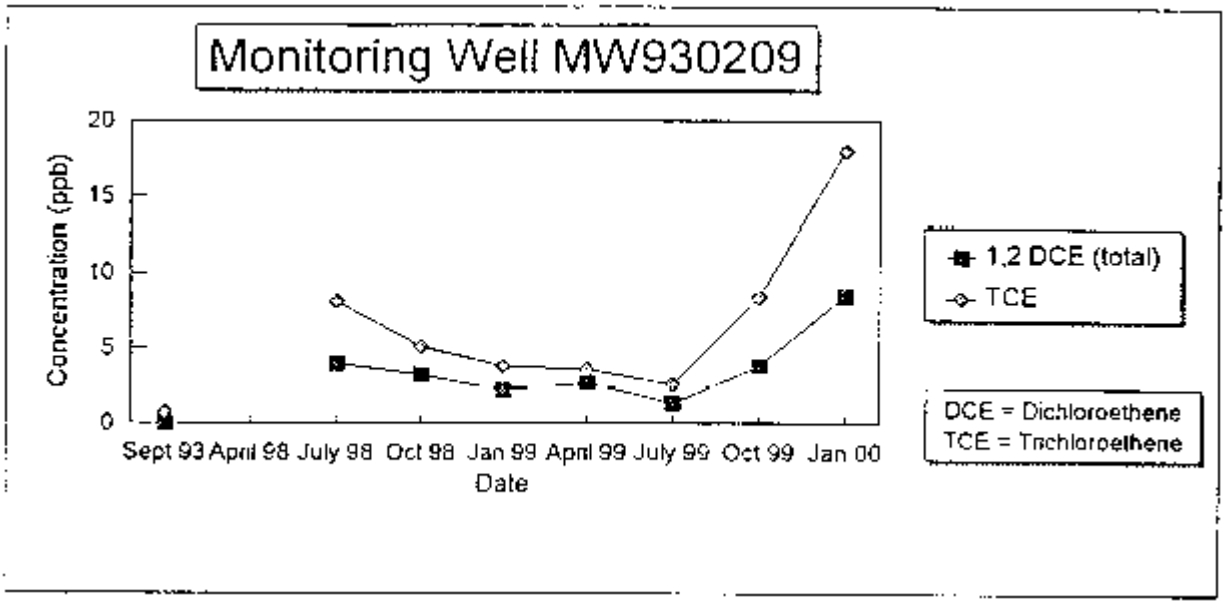


Figure 7-1. Ecological Risk Assessment Structure

APPENDIX A

LTM REPORTING DATA

Figure 7
Ground Water Quality Data
OU-1 LTO/LTM January 2000 Event
Ellsworth Air Force Base



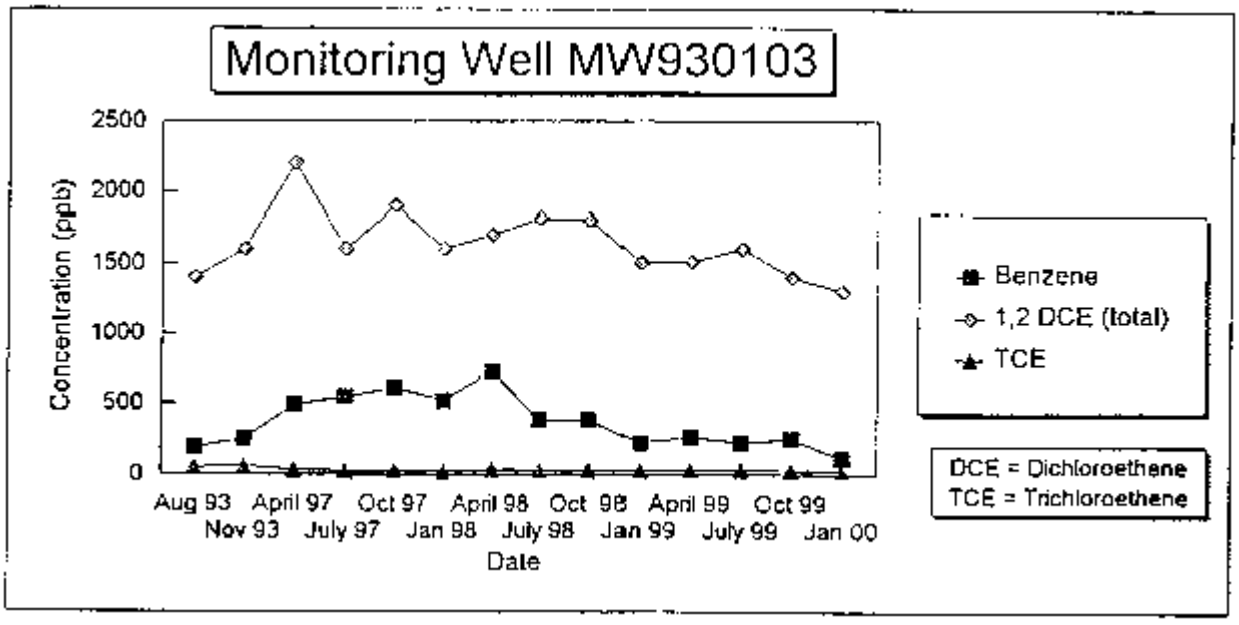
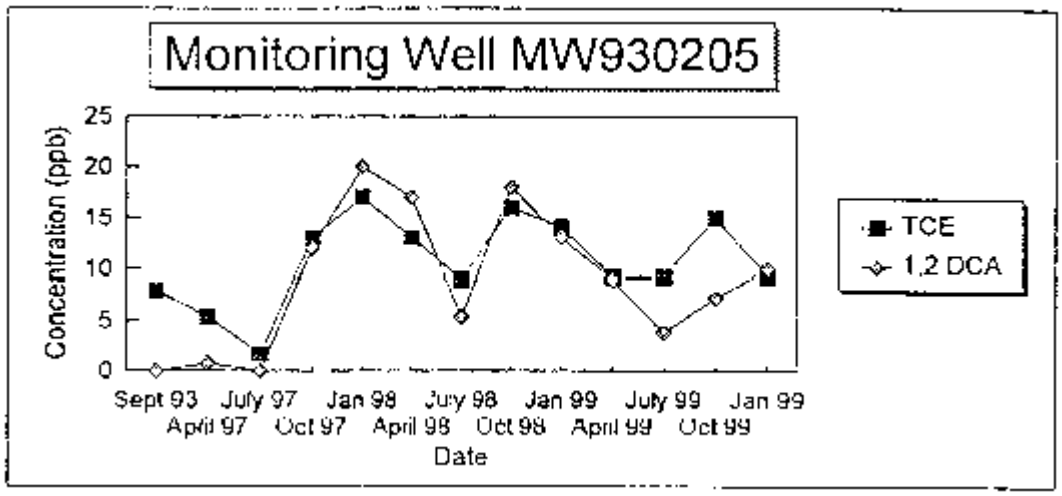


Figure 4
Ground Water Quality Data
OU-2 LTO/LTM January 2000 Event
Ellsworth Air Force Base



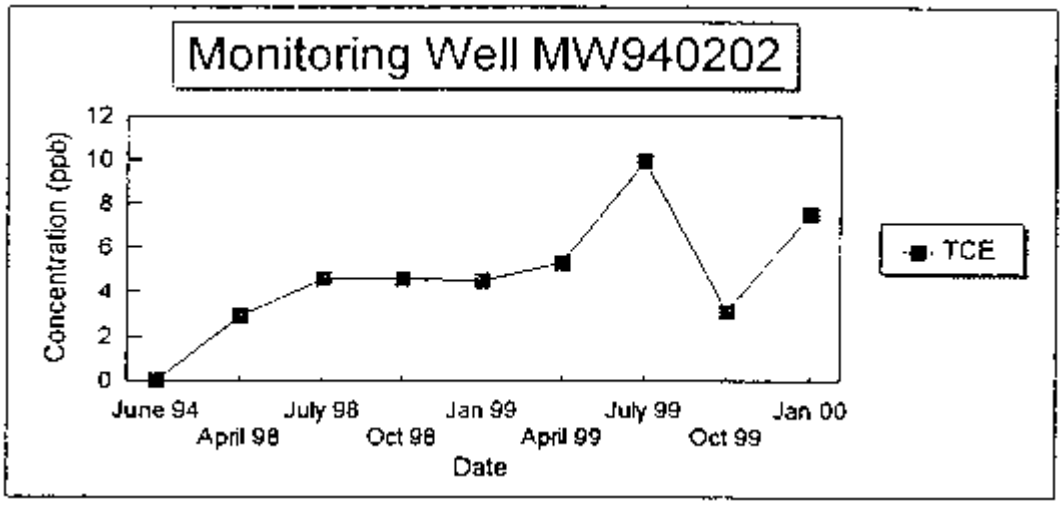
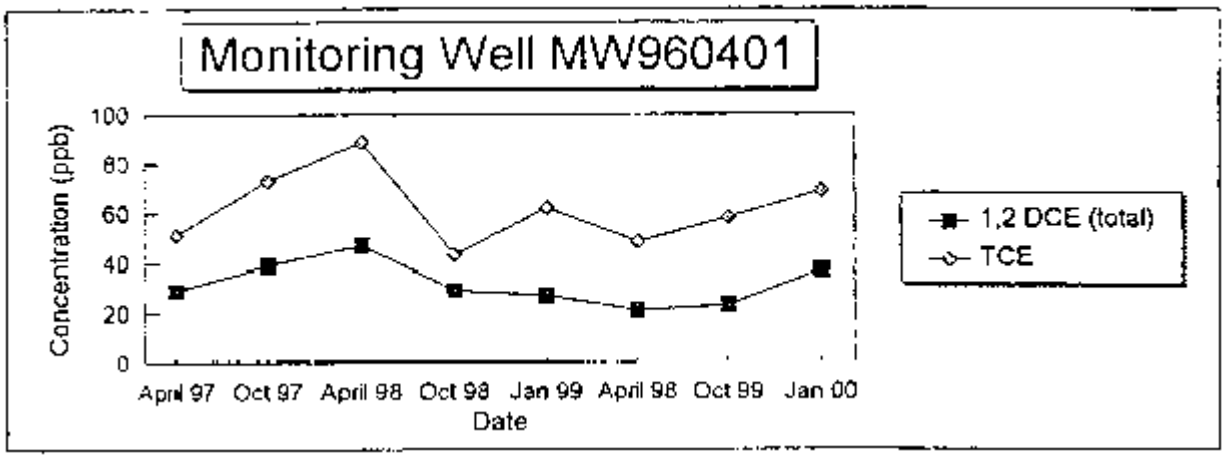
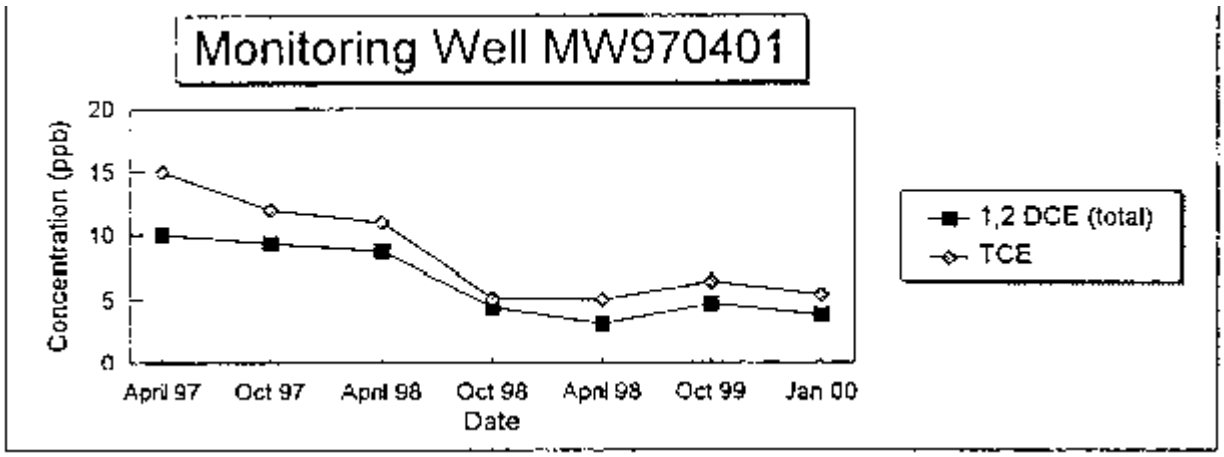
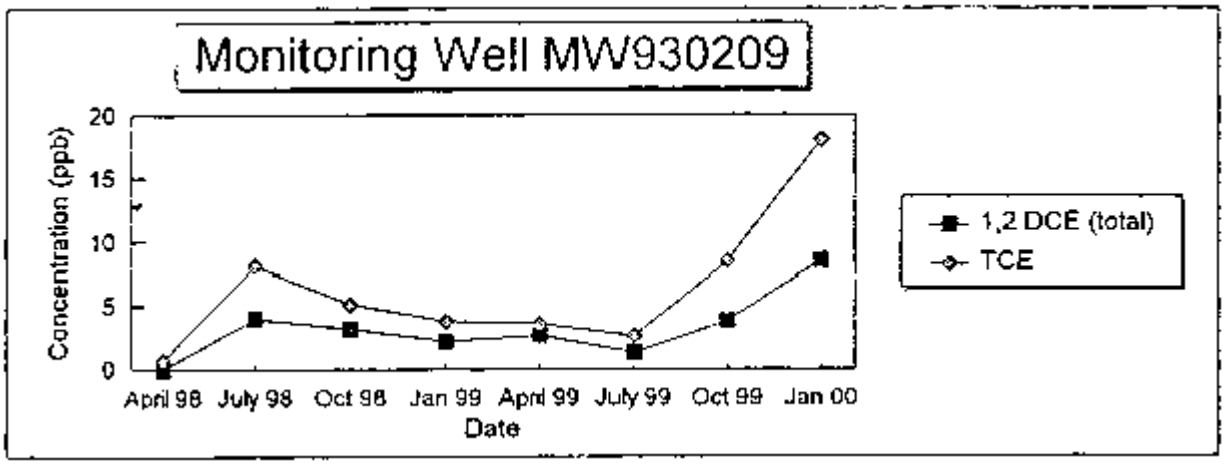


Figure 6
Ground Water Quality Data
OU-4 LTO/LTM January 2000 Event
Ellsworth Air Force Base

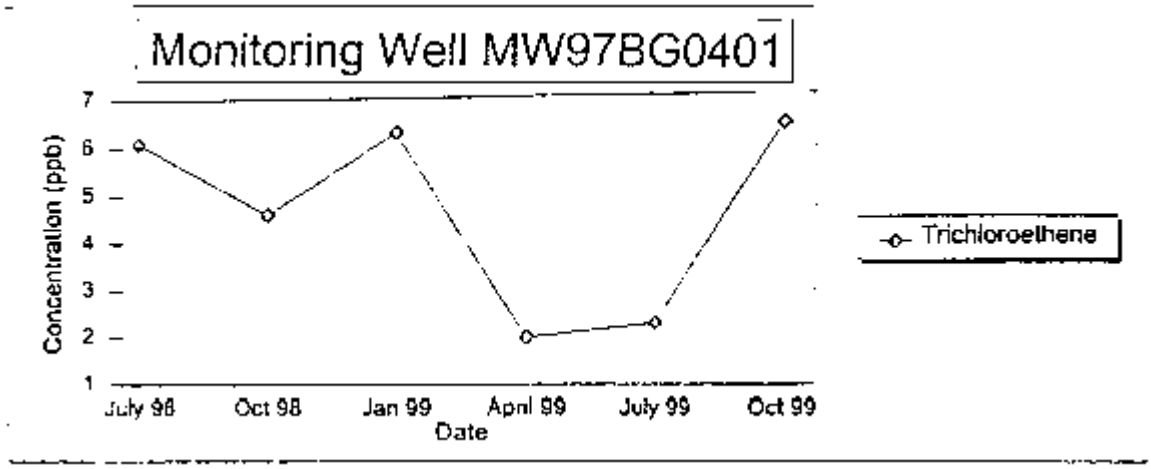


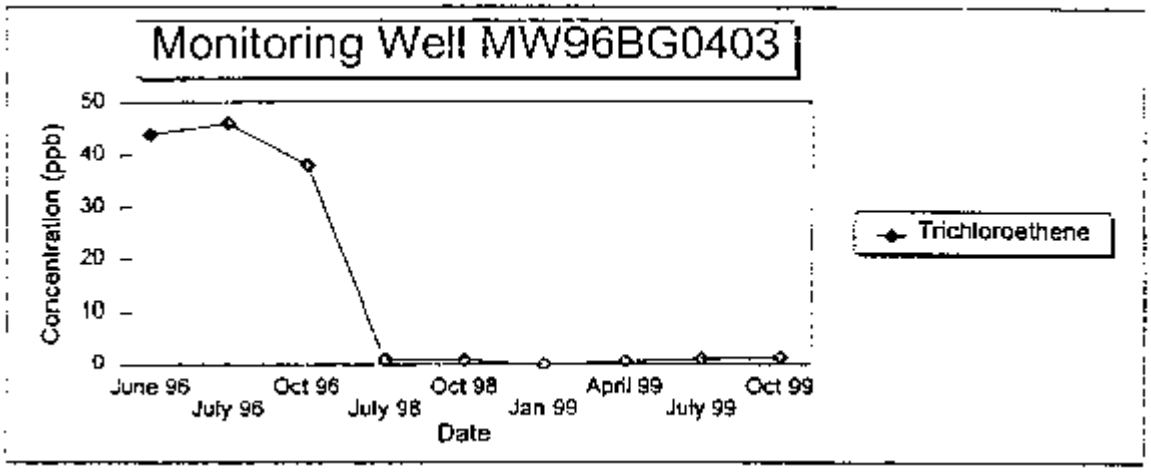




NOTE: DCE = Total dichloroethane
TCE = Trichloroethane

Figure 13
Downgradient Ground Water Quality Data
OU-11 LTO/LTM January 2000 Event
Ellsworth Air Force Base





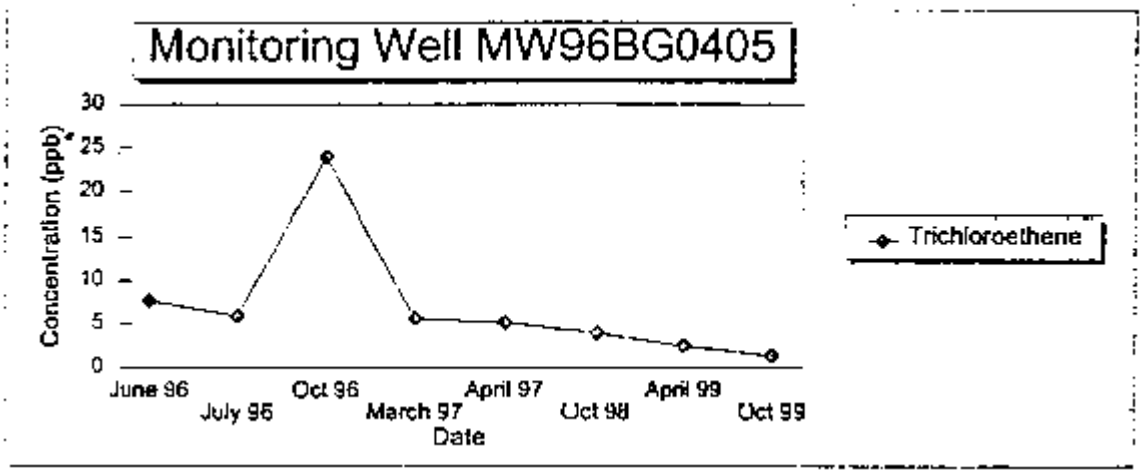
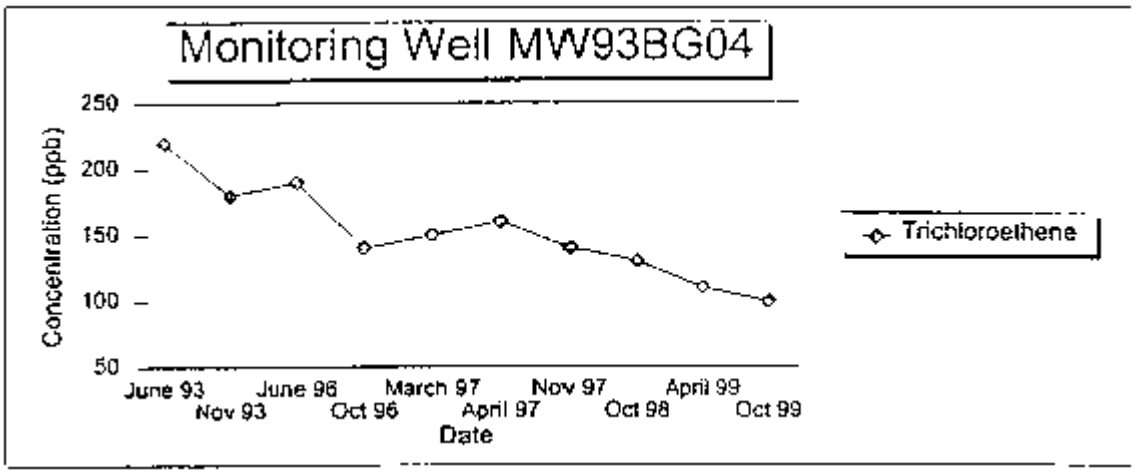
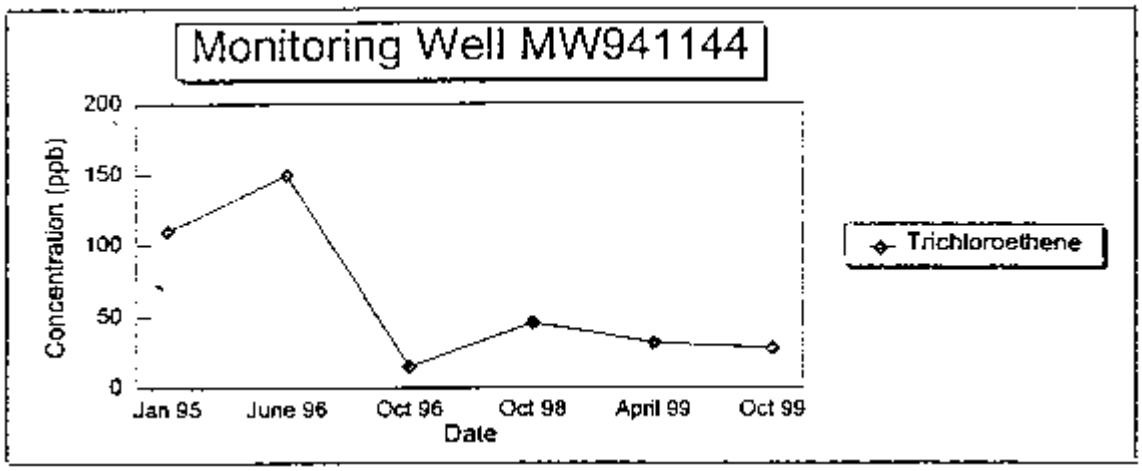


Figure 14
Upgradient Ground Water Quality Data
OU-11 LTO/LTM January 2000 Event
Ellsworth Air Force Base





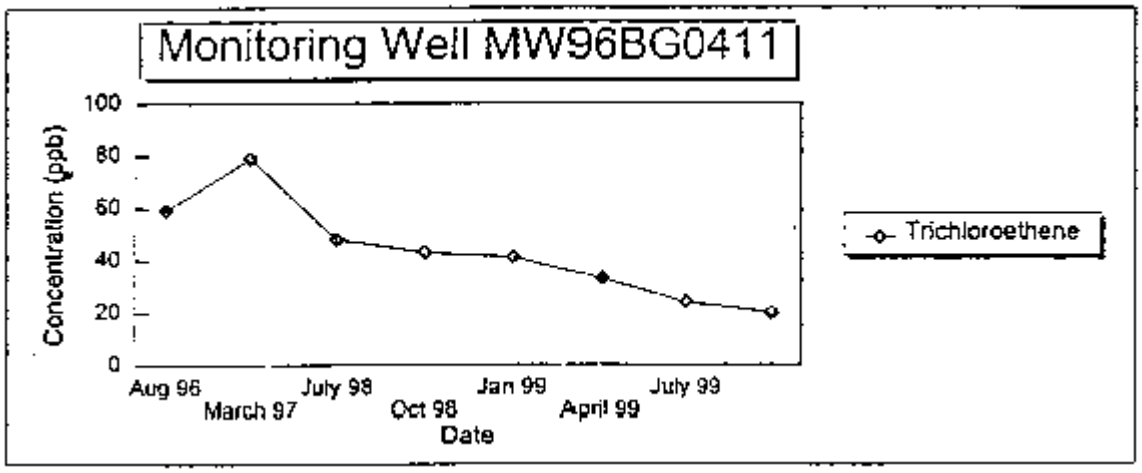
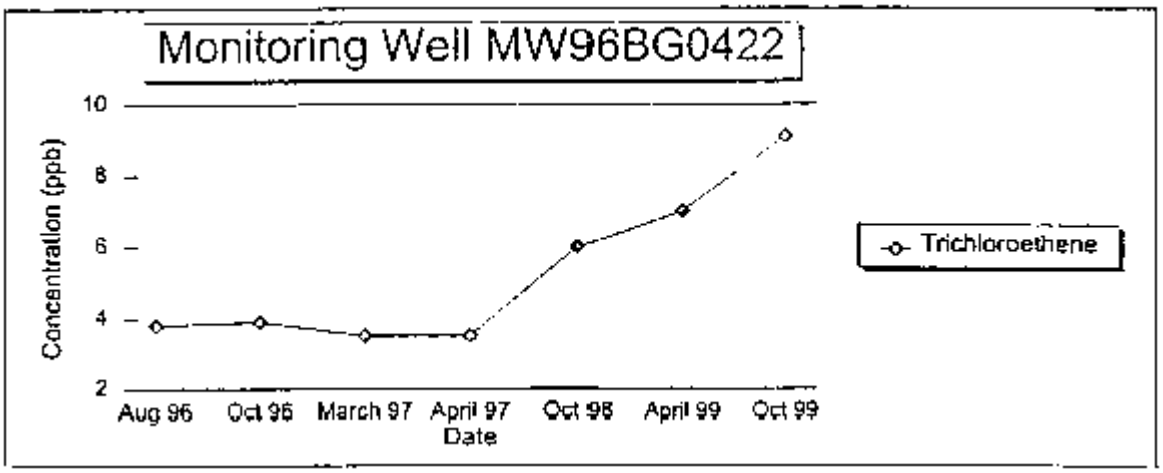
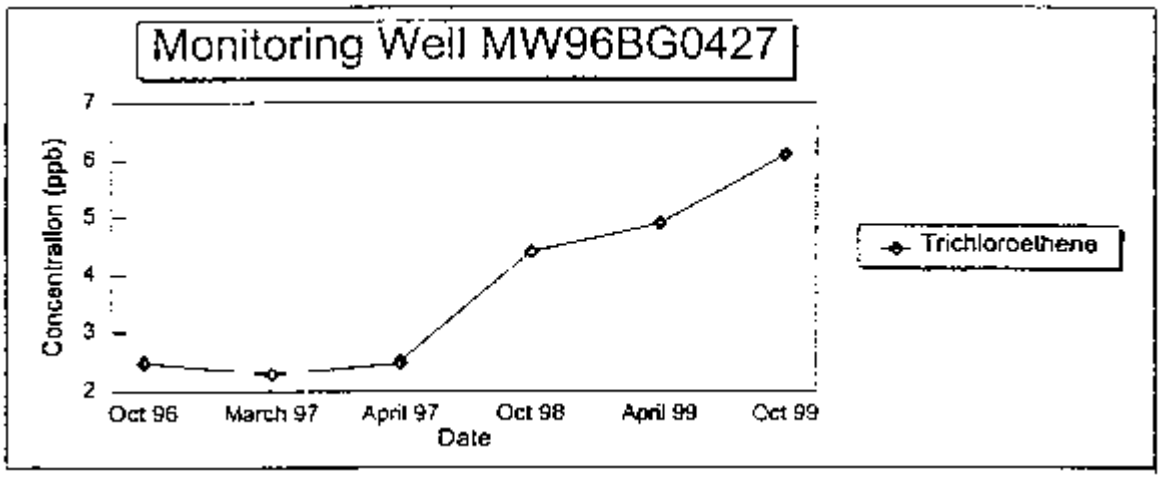
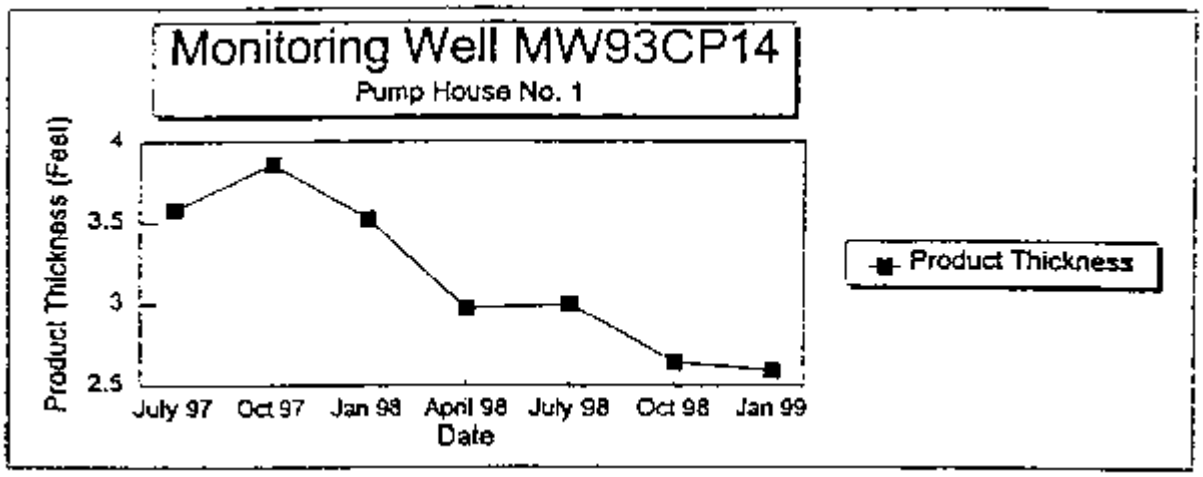


Figure 15
Secondary Channel Ground Water Quality Data
OU-11 LTO/LTM October 1999 Event
Ellsworth Air Force Base





Ground Water Quality Data
FRA LTO/LTM January 1999 Sampling Event
Ellsworth Air Force Base



Attachment D
Summary of Analytical Results
OU-1 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW930101	MW930103	MW930105	MW930107	MW930109	MW930109 DUP	MW930110	MW930209	MW950101	MW960101	MW960103	MW970101
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
PETROLEUM HYDROCARBONS													
DRO	UG/L	2100	1800	450						<100	<100		<100
VOCS													
ACETONE	UG/L	R	R	R	R	R	R	R	R	R	R	R	R
BENZENE	UG/L	35	98	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
BROMODICHLOROMETHANE	UG/L	<5.0	<40	1.2	0.21 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
BROMOFORM	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
BROMOMETHANE	UG/L	<10	<80	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
2-BUTANONE (MEK)	UG/L	R	R	R	R	R	R	R	<5.0 UJ	<19 UJ	R	R	R
CARBON DISULFIDE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CARBON TETRACHLORIDE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CHLOROBENZENE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CHLOROETHANE	UG/L	<10	<80	>2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
CHLOROFORM	UG/L	<5.0 UJ	<40 UJ	<1.0	0.44 J	2.3	2.4	<1.0	<1.0	<1.0	<1.0 UJ	<1.0	<1.0
CHLOROMETHANE	UG/L	<10	<80	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
DIBROMOCHLOROMETHANE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-DICHLOROETHANE	UG/L	<5.0	170	<1.0	<1.0	<1.0	<1.0	4.7	0.15 J	0.54 J	<1.0	<1.0	<1.0
1,2-DICHLOROETHANE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	0.27 J	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-DICHLOROETHENE	UG/L	<5.0	22 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	79	1300	<0.50	<0.50	<0.50	<0.50	21	5.5	36	<0.50	<0.50	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	<2.5	<20	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.38 J	<0.50	<0.50	<0.50
1,2-DICHLOROPROPANE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CIS-1,3-DICHLOROPROPENE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
TRANS-1,3-DICHLOROPROPENE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
ETHYLBENZENE	UG/L	170	94	0.93 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-HEXANONE	UG/L	<25	<200	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
METHYLENE CHLORIDE	UG/L	<5.0	<40 UJ	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-METHYL-2-PENTANONE (MIBK)	UG/L	<25	<200	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
STYRENE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-TETRACHLOROETHANE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
TETRACHLOROETHYLENE (PCE)	UG/L	<5.0	<40	<1.0	0.88 J	<1.0	<1.0	<1.0	<1.0	0.97 J	<1.0	<1.0	<1.0
TOLUENE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<5.0	25 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-TRICHLOROETHANE	UG/L	<5.0	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	6.7	26 J	<1.0	20	<1.0	<1.0	<1.0	11	20	<1.0	0.69 J	<1.0
VINYL CHLORIDE	UG/L	<10	<80	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
XYLENES, TOTAL	UG/L	9.3	<40	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Attachment D
Summary of Analytical Results
OU-2 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW870211	MW930202	MW930203	MW930205	MW930215	MW930216	MW930217	MW930218	MW940202	MW940202 DUP	MW940203	MW960201	MW970201	MW970202
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
PETROLEUM HYDROCARBONS															
GRO	UG/L		130 J	69 J		<25	<25	<25	<25 UJ				830		
DRO	UG/L		250	<100		<100	<100	44 J	93 J				1000		
BTEX															
BENZENE	UG/L		<0.50	<0.50		<0.50	<0.50	<0.50	<0.50				1.4 J		
ETHYLBENZENE	UG/L		<0.50	<0.50		<0.50	<0.50	<0.50	<0.50				74		
TOLUENE	UG/L		<0.50	<0.50		<0.50 UJ	<0.50 UJ	<0.50 UJ	<0.50 UJ				<2.5		
XYLENES, TOTAL	UG/L		0.74J	<0.74 UJ		<0.50	<0.50	<0.50	<0.50				23		
VOCS															
ACETONE	UG/L	R			R	R				R	R	R		R	R
BENZENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
BROMODICHLOROMETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
BROMOFORM	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
BROMOMETHANE	UG/L	<2.0			<2.0	<2.0				<2.0	<2.0	<2.0		<2.0	<2.0
2-BUTANONE (MEK)	UG/L	R			R	R				R	R	R		R	R
CARBON DISULFIDE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CARBON TETRACHLORIDE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CHLOROBENZENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CHLOROETHANE	UG/L	<2.0			<2.0	<2.0				<2.0	<2.0	<2.0		<2.0	<2.0
CHLOROFORM	UG/L	<1.0			<1.0 UJ	<1.0				<1.0 UJ	<1.0 UJ	<1.0		<1.0	<1.0
CHLOROMETHANE	UG/L	<2.0			<2.0	<2.0				<2.0	<2.0	<2.0		<2.0	<2.0
DIBROMOCHLOROMETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1-DICHLOROETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,2-DICHLOROETHANE	UG/L	<1.0			15	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1-DICHLOROETHENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	<0.50			4.3	<0.50				1.2	1.2	<0.50		<0.50	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50			3.4	<0.50				0.20 J	0.19 J	<0.50		<0.50	<0.50
1,2-DICHLOROPROPANE	UG/L	<1.0			0.30 J	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CIS-1,3-DICHLOROPROPENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
TRANS-1,3-DICHLOROPROPENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
ETHYLBENZENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
2-HEXANONE	UG/L	<5.0			<5.0	<5.0				<5.0	<5.0	<5.0		<5.0	<5.0
METHYLENE CHLORIDE	UG/L	<1.0			<1.0 UJ	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
4-METHYL-2-PENTANONE (MIBK)	UG/L	<5.0			<5.0	<5.0				<5.0	<5.0	<5.0		<5.0	<5.0
STYRENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1,2,2-TETRACHLOROETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
TETRACHLOROETHYLENE (PCE)	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
TOLUENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1,2-TRICHLOROETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	<1.0			12	<1.0				5.8	5.7	<1.0		<1.0	<1.0
VINYL CHLORIDE	UG/L	<2.0			<2.0	<2.0				<2.0	<2.0	<2.0		<2.0	<2.0
XYLENES, TOTAL	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
WATER QUALITY PARAMETERS															
TOTAL DISSOLVED SOLIDS	MG/L	3730			3670					3210	3240	7660		1370	979
CHLORIDE (AS CL)	MG/L	112			178					79.4	79.7	87.1		49.0	30.6
SULFATE (AS SO4)	MG/L	2350 J			1900 J					1790 J	1740 J	4710 J		531 J	315 J

Attachment D
Summary of Analytical Results
OU-2 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW870211	MW930202	MW930203	MW930205	MW930215	MW930216	MW930217	MW930218	MW940202	MW940202 DUP	MW940203	MW960201	MW970201	MW970202
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
PETROLEUM HYDROCARBONS															
GRO	UG/L		130 J	69 J		<25	<25	<25	<25 UJ				830		
DRO	UG/L		250	<100		<100	<100	44 J	93 J				1000		
BTEX															
BENZENE	UG/L		<0.50	<0.50		<0.50	<0.50	<0.50	<0.50				1.4 J		
ETHYLBENZENE	UG/L		<0.50	<0.50		<0.50	<0.50	<0.50	<0.50				74		
TOLUENE	UG/L		<0.50	<0.50		<0.50 UJ	<0.50 UJ	<0.50 UJ	<0.50 UJ				<2.5		
XYLENES, TOTAL	UG/L		<0.50	<0.50		<0.50	<0.50	<0.50	<0.50				23		
VOCS															
ACETONE	UG/L	R			R	R				R	R	R		R	R
BENZENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
BROMODICHLOROMETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
BROMOFORM	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
BROMOMETHANE	UG/L	<2.0			<2.0	<2.0				<2.0	<2.0	<2.0		<2.0	<2.0
2-BUTANONE (MEK)	UG/L	R			R	R				R	R	R		R	R
CARBON DISULFIDE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CARBON TETRACHLORIDE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CHLOROBENZENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CHLOROETHANE	UG/L	<2.0			<2.0	<2.0				<2.0	<2.0	<2.0		<2.0	<2.0
CHLOROFORM	UG/L	<1.0			<1.0 UJ	<1.0				<1.0 UJ	<1.0 UJ	<1.0		<1.0	<1.0
CHLOROMETHANE	UG/L	<2.0			<2.0	<2.0				<2.0	<2.0	<2.0		<2.0	<2.0
DIBROMOCHLOROMETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1-DICHLOROETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,2-DICHLOROETHANE	UG/L	<1.0			15	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1-DICHLOROETHENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	<0.50			4.3	<0.50				1.2	1.2	<0.50		<0.50	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50			3.4	<0.50				0.20 J	0.19 J	<0.50		<0.50	<0.50
1,2-DICHLOROPROPANE	UG/L	<1.0			0.30 J	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
CIS-1,3-DICHLOROPROPENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
TRANS-1,3-DICHLOROPROPENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
ETHYLBENZENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
2-HEXANONE	UG/L	<5.0			<5.0	<5.0				<5.0	<5.0	<5.0		<5.0	<5.0
METHYLENE CHLORIDE	UG/L	<1.0			<1.0 UJ	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
4-METHYL-2-PENTANONE (MIBK)	UG/L	<5.0			<5.0	<5.0				<5.0	<5.0	<5.0		<5.0	<5.0
STYRENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1,2,2-TETRACHLOROETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
TETRACHLOROETHYLENE (PCE)	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
TOLUENE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
1,1,2-TRICHLOROETHANE	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	<1.0			12	<1.0				5.8	5.7	<1.0		<1.0	<1.0
VINYL CHLORIDE	UG/L	<2.0			<2.0	<2.0				<2.0	<2.0	<2.0		<2.0	<2.0
XYLENES, TOTAL	UG/L	<1.0			<1.0	<1.0				<1.0	<1.0	<1.0		<1.0	<1.0
WATER QUALITY PARAMETERS															
TOTAL DISSOLVED SOLIDS	MG/L	3730			3670					3210	3240	7660		1370	979
CHLORIDE (AS CL)	MG/L	112			178					79.4	79.7	87.1		49.0	30.6
SULFATE (AS SO4)	MG/L	2350 J			1900 J					1790 J	1740 J	4710 J		531 J	315 J

Attachment D
Summary of Analytical Results
OU-3 LTO/LTM July 1999 Sampling Event
Ellsworth Air Force Base

		MW970301	MW970302	MW970303	MW970303 DUP	MW970304
ANALYTES	UNITS	JUL 1999	JUL 1999	JUL 1999	JUL 1999	JUL 1999
VOCS						
ACETONE	UG/L	R	R	R	R	R
BENZENE	UG/L	0.27 J	<1.0	0.79 J	0.77 J	<1.0
BROMODICHLOROMETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
BROMOFORM	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
BROMOMETHANE	UG/L	<2.0	<2.0	<2.0	<2.0	<2.0
2-BUTANONE (MEK)	UG/L	R	R	R	R	R
CARBON DISULFIDE	UG/L	<1.0	<1.0	0.81 J	0.86 J	<1.0
CARBON TETRACHLORIDE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
CHLOROBENZENE	UG/L	<1.0	<1.0	0.21 J	<1.0	<1.0 UJ
CHLOROETHANE	UG/L	<2.0	<2.0	<2.0	<2.0	<2.0
CHLOROFORM	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
CHLOROMETHANE	UG/L	<2.0	<2.0	0.39 J	0.34 J	<2.0
DIBROMOCHLOROMETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-DICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-DICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-DICHLOROETHENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	<0.50	<0.50	<0.50	<0.50	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50	<0.50	<0.50	<0.50	<0.50
1,2-DICHLOROPROPANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
CIS-1,3-DICHLOROPROPENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
TRANS-1,3-DICHLOROPROPENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
ETHYLBENZENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
2-HEXANONE	UG/L	<5.0	<5.0	<5.0	<5.0	<5.0
METHYLENE CHLORIDE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
4-METHYL-2-PENTANONE (MIBK)	UG/L	<5.0	<5.0	<5.0	<5.0	<5.0
STYRENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-TETRACHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
TETRACHLOROETHYLENE (PCE)	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
TOLUENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-TRICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
VINYL CHLORIDE	UG/L	<2.0	<2.0	<2.0	<2.0	<2.0
XYLENES, TOTAL	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0

Attachment D
Summary of Analytical Results
OU-3 LTO/LTM July 1999 Sampling Event
Ellsworth Air Force Base

		MW970301	MW970302	MW970303	MW970303 DUP	MW970304
ANALYTES	UNITS	JUL 1999	JUL 1999	JUL 1999	JUL 1999	JUL 1999
INORGANICS						
ANTIMONY	UG/L	<2.0 UJ	<2.0	<2.0	<2.0	<2.0
ARENIC	UG/L	4.8 J	3.2 J	5.2 J	5.7 J	3.0 J
BARIUM	MG/L	0.0165	0.0135	0.0174	0.0196	0.0089 J
BERYLLIUM	MG/L	<0.005	<0.005 UJ	<0.005	<0.005	<0.005
CADMIUM	UG/L	<1.0 UJ	<1.0 UJ	<1.0 UJ	<1.0 UJ	<1.0
CHROMIUM	MG/L	<0.010	<0.010	<0.010	<0.010	<0.010
COBALT	MG/L	<0.010	<0.010	0.0110	0.0118	<0.010
COPPER	MG/L	<0.010	<0.010	0.0024 J	0.0027 J	<0.010
LEAD	MG/L	0.00014 J	0.00017 J	0.0011 J	0.00052 J	0.00012 J
NICKEL	MG/L	<0.040	<0.040	0.0156 J	0.0173 J	<0.040
SILVER	MG/L	<0.010	<0.010	<0.010	<0.010	<0.010
THALLIUM	UG/L	<1.0 UJ	<1.0 UJ	<1.0 UJ	<1.0 UJ	<1.0
VANADIUM	MG/L	<0.010	<0.010	0.0027 J	0.0020 J	<0.010
ZINC	MG/L	<0.02 UJ	<0.02 UJ	<0.02 UJ	<0.02 UJ	<0.02 UJ
PAHS						
ACENAPHTHENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
ACENAPHTHYLENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
ANTHRACENE	UG/L	<0.10	<0.10	<0.10	<0.10	<0.10
BENZO(A)ANTHRACENE	UG/L	<0.10	<0.10	<0.10	<0.10	<0.10
BENZO(A)PYRENE	UG/L	<0.10	<0.10	<0.10	<0.10	0.077 J
BENZO(B)FLUORANTHENE	UG/L	<0.10	<0.10	<0.10	<0.10	<0.10
BENZO(G,H,I)PERYLENE	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20
BENZO(K)FLUORANTHENE	UG/L	<0.10	<0.10	<0.10	<0.10	<0.10
CHRYSENE	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20
DIBENZ(A,h)ANTHRACENE	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20
FLUORANTHENE	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20
FLUORENE	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20
INDENO(1,2,3-C,D)PYRENE	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20
NAPHTHALENE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0
PHENANTHRENE	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20
PYRENE	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20
WATER QUALITY PARAMETERS						
CHLORIDE (AS CL)	MG/L	55.2	70.0	265	252	26.4
SULFATE (AS SO4)	MG/L	3480	4800	6900	6640	3050 J
TOTAL DISSOLVED SOLIDS	MG/L	5750	7650	11100	11300	4930

Attachment D
Summary of Analytical Results
OU-4 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW870404	MW870405	MW870405 DUP	MW930209	MW930215	MW930412	MW930416	MW930416 DUP	MW930417	MW930418	MW930420	MW930422	MW930423
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
PETROLEUM HYDROCARBONS														
GRO	UG/L					<25								
DRO						<100								
BTEX														
BENZENE						<0.50								
ETHYLBENZENE						<0.50								
TOLUENE						<0.50 UJ								
XYLENES, TOTAL						<0.50								
VOCS														
ACETONE	UG/L	R	R		R	R								
BENZENE	UG/L	<2.0	0.93 J		<1.0	<1.0								
BROMODICHLOROMETHANE	UG/L	<2.0	<1.0		<1.0	<1.0								
BROMOFORM	UG/L	<2.0	<1.0		<1.0	<1.0								
BROMOMETHANE	UG/L	<4.0	<2.0		<2.0	<2.0								
2-BUTANONE (MEK)	UG/L	R	R		<5.0 UJ	R								
CARBON DISULFIDE	UG/L	<2.0	<1.0		<1.0	<1.0								
CARBON TETRACHLORIDE	UG/L	<2.0	<1.0		<1.0	<1.0								
CHLOROBENZENE	UG/L	<2.0	2.7 UJ		<1.0	<1.0								
CHLOROETHANE	UG/L	<4.0	0.96 J		<2.0	<2.0								
CHLOROFORM	UG/L	<2.0	<1.0		<1.0	<1.0								
CHLOROMETHANE	UG/L	<4.0	<2.0		<2.0	<2.0								
DIBROMOCHLOROMETHANE	UG/L	<2.0	<1.0		<1.0	<1.0								
1,1-DICHLOROETHANE	UG/L	1.5 J	4.7		0.15 J	<1.0	0.30 J	0.17 J	0.17 J	2.6	1.2 J	<1.0	<1.0	<1.0
1,2-DICHLOROETHANE	UG/L	<2.0	0.65 J		<1.0	<1.0								
1,1-DICHLOROETHENE	UG/L	<2.0	<1.0		<1.0	<1.0								
CIS-1,2-DICHLOROETHYLENE	UG/L	33	22		5.5	<0.50	26	3.6	3.5	9.6	160	<0.50	<0.50	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	<1.0	0.25 J		<0.50	<0.50	0.26 J	<0.50	<0.50	<0.50	<5.0	<0.50	<0.50	<0.50
1,2-DICHLOROPROPANE	UG/L	1.0 J	1.7		<1.0	<1.0								
CIS-1,3-DICHLOROPROPENE	UG/L	<2.0	<1.0		<1.0	<1.0								
TRANS-1,3-DICHLOROPROPENE	UG/L	<2.0	<1.0		<1.0	<1.0								
ETHYLBENZENE	UG/L	<2.0	0.87 J		<1.0	<1.0								
2-HEXANONE	UG/L	<10	<5.0		<5.0	<5.0								
METHYLENE CHLORIDE	UG/L	<2.0 UJ	<1.0 UJ		<1.0	<1.0								
4-METHYL-2-PENTANONE (MIBK)	UG/L	<10	<5.0		<5.0	<5.0								
STYRENE	UG/L	<2.0	<1.0		<1.0	<1.0								
1,1,2,2-TETRACHLOROETHANE	UG/L	<2.0	<1.0		<1.0	<1.0								
TETRACHLOROETHYLENE (PCE)	UG/L	<2.0	<1.0		<1.0	<1.0	0.35 J	<1.0	<1.0	0.45 J	<1.0	<1.0	<1.0	<1.0
TOLUENE	UG/L	<2.0	0.14 J		<1.0	<1.0								
1,1,1-TRICHLOROETHANE	UG/L	2.3	<1.0		<1.0	<1.0	<1.0	<1.0	<1.0	0.51 J	<1.0	<1.0	<1.0	<1.0
1,1,2-TRICHLOROETHANE	UG/L	<2.0	<1.0		<1.0	<1.0								
TRICHLOROETHYLENE (TCE)	UG/L	68	1.8		11	<1.0	5.5	5.0	4.9	3.3	310	<1.0	0.39 J	0.20 J
VINYL CHLORIDE	UG/L	<4.0	9.1		<2.0	<2.0	7.5	<2.0	<2.0	<2.0	<20	<2.0	<2.0	<2.0
XYLENES, TOTAL	UG/L	<2.0	<1.0		<1.0	<1.0								

Attachment D
Summary of Analytical Results
OU-4 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW870404	MW870405	MW870405 DUP	MW930209	MW930215	MW930412	MW930416	MW930416 DUP	MW930417	MW930418	MW930420	MW930422	MW930423
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
SVOCS														
ACENAPHTHENE	UG/L		<10	<10										
ACENAPHTHYLENE	UG/L		<10	<10										
ANTHRACENE	UG/L		<10	<10										
BENZO(A)ANTHRACENE	UG/L		<10	<10										
BENZO(B)FLUORANTHENE	UG/L		<10	<10										
BENZO(K)FLUORANTHENE	UG/L		<10	<10										
BENZOIC ACID	UG/L		<50	<50										
BENZO(G,H,I)PERYLENE	UG/L		<10	<10										
BENZO(A)PYRENE	UG/L		<10	<10										
BENZYL ALCOHOL	UG/L		<10	<10										
4-BROMOPHENYL PHENYL ETHER	UG/L		<10	<10										
BENZYL BUTYL PHTHALATE	UG/L		<10	<10										
CARBAZOLE	UG/L		<10	<10										
4-CHLOROANILINE	UG/L		<10	<10										
BIS(2-CHLOROETHOXY) METHANE	UG/L		<10	<10										
BIS(2-CHLOROETHYL) ETHER	UG/L		6.0 J	5.2 J										
BIS(2-CHLOROISOPROPYL) ETHER	UG/L		<10	<10										
4-CHLORO-3-METHYLPHENOL	UG/L		<10	<10										
2-CHLORONAPHTHALENE	UG/L		<10	<10										
2-CHLOROPHENOL	UG/L		<10	<10										
4-CHLOROPHENYL PHENYL ETHER	UG/L		<10	<10										
CHRYSENE	UG/L		<10	<10										
DIBENZ(A,H)ANTHRACENE	UG/L		<10	<10										
DIBENZOFURAN	UG/L		<10	<10										
DI-N-BUTYL PHTHALATE	UG/L		<10	<10										
1,2-DICHLOROBENZENE	UG/L		<10	<10										
1,3-DICHLOROBENZENE	UG/L		74	60										
1,4-DICHLOROBENZENE	UG/L		5.6 J	<10										
3,3-DICHLOROBENZIDINE	UG/L		R	R										
2,4-DICHLOROPHENOL	UG/L		<10	<10										
DIETHYLPHTHALATE	UG/L		<10	<10										
2,4-DIMETHYLPHENOL	UG/L		<10	<10										
DIMETHYL PHTHALATE	UG/L		<10	<10										
4,6-DINITRO-2-METHYLPHENOL	UG/L		<50	<50										
2,4-DINITROPHENOL	UG/L		<50	<50										
2,4-DINITROTOLUENE	UG/L		<10	<10										
2,6-DINITROTOLUENE	UG/L		<10	<10										
DI-N-OCTYLPHTHALATE	UG/L		<10	<10										
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L		<10	<10										
FLUORANTHENE	UG/L		<10	<10										
FLUORENE	UG/L		<10	<10										
HEXACHLOROBENZENE	UG/L		<10	<10										

Attachment D
Summary of Analytical Results
OU-4 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW870404	MW870405	MW870405 DUP	MW930209	MW930215	MW930412	MW930416	MW930416 DUP	MW930417	MW930418	MW930420	MW930422	MW930423
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
SVOCS cont.														
HEXACHLOROBUTADIENE	UG/L		<10	<10										
HEXACHLOROCYCLOPENTADIENE	UG/L		<50	<50										
HEXACHLOROETHANE	UG/L		<10	<10										
INDENO(1,2,3-C,D)PYRENE	UG/L		<10	<10										
ISOPHORONE	UG/L		<10	<10										
2-METHYLNAPHTHALENE	UG/L		<10	<10										
2-METHYLPHENOL (O-CRESOL)	UG/L		<10	<10										
3-NITROANILINE	UG/L		<10	<10										
4-METHYLPHENOL (P-CRESOL)	UG/L		<10	<10										
NAPHTHALENE	UG/L		<50	<50										
2-NITROANILINE3-NITROANILINE	UG/L		<50 UJ	<50 UJ										
4-NITROANILINE	UG/L		<50	<50										
NITROBENZENE	UG/L		<10	<10										
2-NITROPHENOL	UG/L		<10	<10										
4-NITROPHENOL	UG/L		<50	<50										
N-NITROSODIPHENYLAMINE	UG/L		<10	<10										
N-NITROSODI-N-PROPYLAMINE	UG/L		<10	<10										
PENTACHLOROPHENOL	UG/L		<50	<50										
PHENANTHRENE	UG/L		<10	<10										
PHENOL	UG/L		<10	<10										
PYRENE	UG/L		<10	<10										
1,2,4-TRICHLOROBENZENE	UG/L		130	110										
2,4,5-TRICHLOROPHENOL	UG/L		<10	<10										
2,4,6-TRICHLOROPHENOL	UG/L		<10	<10										
WATER QUALITY PARAMETERS														
TOTAL DISSOLVED SOLIDS	MG/L	1080	1250	1380										
CHLORIDE (AS CL)	MG/L	130 J	90.1 J	86.0 J										
SULFATE (AS SO4)	MG/L	260 J	197 J	213 J										

Attachment D
Summary of Analytical Results
OU-4 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW930424	MW930425	MW940401	MW960401	MW960402	MW960405	MW960405 DUP	MW960407	MW960408	MW970401	MW990401
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
PETROLEUM HYDROCARBONS												
GRO												
DRO												
BTEX												
BENZENE												
ETHYLBENZENE												
TOLUENE												
XYLENES, TOTAL												
VOCS												
ACETONE	UG/L			R					R			
BENZENE	UG/L			0.90 J					<1.0			
BROMODICHLOROMETHANE	UG/L			<1.0					<1.0			
BROMOFORM	UG/L			<1.0					<1.0			
BROMOMETHANE	UG/L			<2.0					<2.0			
2-BUTANONE (MEK)	UG/L			<5.0 UJ					<5.0 UJ			
CARBON DISULFIDE	UG/L			<1.0					<1.0			
CARBON TETRACHLORIDE	UG/L			<1.0					<1.0			
CHLOROBENZENE	UG/L			<1.0					<1.0			
CHLOROETHANE	UG/L			<2.0					<2.0			
CHLOROFORM	UG/L			<1.0					<1.0			
CHLOROMETHANE	UG/L			<2.0					<2.0			
DIBROMOCHLOROMETHANE	UG/L			<1.0					<1.0			
1,1-DICHLOROETHANE	UG/L	0.18 J	<1.0	<1.0	0.18 J	<1.0	0.79 J	0.76 J	0.24 J	<1.0	0.53 J	<1.0
1,2-DICHLOROETHANE	UG/L			<1.0					<1.0			
1,1-DICHLOROETHENE	UG/L			<1.0					<1.0			
CIS-1,2-DICHLOROETHYLENE	UG/L	0.48 J	<0.50	17	28	<0.50	2.6	2.6	6.5	0.38 J	5.3	1.3
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,2-DICHLORORPROPANE	UG/L			<1.0					<1.0			
CIS-1,3-DICHLOROPROPENE	UG/L			<1.0					<1.0			
TRANS-1,3-DICHLOROPROPENE	UG/L			<1.0					<1.0			
ETHYLBENZENE	UG/L			<1.0					<1.0			
2-HEXANONE	UG/L			<5.0					<5.0			
METHYLENE CHLORIDE	UG/L			<1.0 UJ					<1.0			
4-METHYL-2-PENTANONE (MIBK)	UG/L			<5.0					<5.0			
STYRENE	UG/L			<1.0					<1.0			
1,1,2,2-TETRACHLOROETHANE	UG/L			<1.0					<1.0			
TETRACHLOROETHYLENE (PCE)	UG/L	<1.0	<1.0	0.25 J	<1.0	<1.0	<1.0	<1.0	0.32 J	<1.0	<1.0	<1.0
TOLUENE	UG/L			<1.0					<1.0			
1,1,1-TRICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	0.25 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-TRICHLOROETHANE	UG/L			<1.0					<1.0			
TRICHLOROETHYLENE (TCE)	UG/L	0.50 J	<1.0	1.9	58	<1.0	2.6	2.5	1.0	5.5	7.2	4.1
VINYL CHLORIDE	UG/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
XYLENES, TOTAL	UG/L			<1.0					<1.0			

Attachment D
Summary of Analytical Results
OU-4 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW930424	MW930425	MW940401	MW960401	MW960402	MW960405	MW960405 DUP	MW960407	MW960408	MW970401	MW990401
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
SVOCS												
ACENAPHTHENE	UG/L											
ACENAPHTHYLENE	UG/L											
ANTHRACENE	UG/L											
BENZO(A)ANTHRACENE	UG/L											
BENZO(B)FLUORANTHENE	UG/L											
BENZO(K)FLUORANTHENE	UG/L											
BENZOIC ACID	UG/L											
BENZO(G,H,I)PERYLENE	UG/L											
BENZO(A)PYRENE	UG/L											
BENZYL ALCOHOL	UG/L											
4-BROMOPHENYL PHENYL ETHER	UG/L											
BENZYL BUTYL PHTHALATE	UG/L											
CARBAZOLE	UG/L											
4-CHLOROANILINE	UG/L											
BIS(2-CHLOROETHOXY) METHANE	UG/L											
BIS(2-CHLOROETHYL) ETHER	UG/L											
BIS(2-CHLOROISOPROPYL) ETHER	UG/L											
4-CHLORO-3-METHYLPHENOL	UG/L											
2-CHLORONAPHTHALENE	UG/L											
2-CHLOROPHENOL	UG/L											
4-CHLOROPHENYL PHENYL ETHER	UG/L											
CHRYSENE	UG/L											
DIBENZ(A,H)ANTHRACENE	UG/L											
DIBENZOFURAN	UG/L											
DI-N-BUTYL PHTHALATE	UG/L											
1,2-DICHLOROBENZENE	UG/L											
1,3-DICHLOROBENZENE	UG/L											
1,4-DICHLOROBENZENE	UG/L											
3,3-DICHLOROBENZIDINE	UG/L											
2,4-DICHLOROPHENOL	UG/L											
DIETHYLPHTHALATE	UG/L											
2,4-DIMETHYLPHENOL	UG/L											
DIMETHYL PHTHALATE	UG/L											
4,6-DINITRO-2-METHYLPHENOL	UG/L											
2,4-DINITROPHENOL	UG/L											
2,4-DINITROTOLUENE	UG/L											
2,6-DINITROTOLUENE	UG/L											
DI-N-OCTYLPHTHALATE	UG/L											
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L											
FLUORANTHENE	UG/L											
FLUORENE	UG/L											
HEXACHLOROBENZENE	UG/L											

Attachment D
Summary of Analytical Results
OU-4 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW930424	MW930425	MW940401	MW960401	MW960402	MW960405	MW960405 DUP	MW960407	MW960408	MW970401	MW990401
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
SVOCS cont.												
HEXACHLOROBUTADIENE	UG/L											
HEXACHLOROCYCLOPENTADIENE	UG/L											
HEXACHLOROETHANE	UG/L											
INDENO(1,2,3-C,D)PYRENE	UG/L											
ISOPHORONE	UG/L											
2-METHYLNAPHTHALENE	UG/L											
2-METHYLPHENOL (O-CRESOL)	UG/L											
3-NITROANILINE	UG/L											
4-METHYLPHENOL (P-CRESOL)	UG/L											
NAPHTHALENE	UG/L											
2-NITROANILINE3-NITROANILINE	UG/L											
4-NITROANILINE	UG/L											
NITROBENZENE	UG/L											
2-NITROPHENOL	UG/L											
4-NITROPHENOL	UG/L											
N-NITROSODIPHENYLAMINE	UG/L											
N-NITROSODI-N-PROPYLAMINE	UG/L											
PENTACHLOROPHENOL	UG/L											
PHENANTHRENE	UG/L											
PHENOL	UG/L											
PYRENE	UG/L											
1,2,4-TRICHLOROBENZENE	UG/L											
2,4,5-TRICHLOROPHENOL	UG/L											
2,4,6-TRICHLOROPHENOL	UG/L											
WATER QUALITY PARAMETERS												
TOTAL DISSOLVED SOLIDS	MG/L			1930					2230			
CHLORIDE (AS CL)	MG/L			58.1 J					78.2 J			
SULFATE (AS SO4)	MG/L			867 J					972 J			

Attachment D
Summary of Analytical Results
OU-5 LTO/LTM July 1999 Sampling event
Ellsworth Air Force Base

ANALYTES	UNITS	MW870501 JUL 1999	MW930501 JUL 1999	MW950501 JUL 1999	MW970501 JUL 1999
VOCS					
ACETONE	UG/L	R	R	R	R
BENZENE	UG/L	<1.0	<1.0	<1.0	<1.0
BROMODICHLOROMETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
BROMOFORM	UG/L	<1.0	<1.0	<1.0	<1.0
BROMOMETHANE	UG/L	<2.0	<2.0	<2.0	<2.0
2-BUTANONE (MEK)	UG/L	R	R	R	R
CARBON DISULFIDE	UG/L	<1.0	<1.0	<1.0	<1.0
CARBON TETRACHLORIDE	UG/L	<1.0	<1.0	<1.0	<1.0
CHLOROBENZENE	UG/L	0.41 J	0.33 J	0.21 J	0.21 J
CHLOROETHANE	UG/L	<2.0	<2.0	<2.0	<2.0
CHLOROFORM	UG/L	<1.0	<1.0	<1.0	<1.0
CHLOROMETHANE	UG/L	0.41 J	0.32 j	0.24 J	0.65 J
DIBROMOCHLOROMETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1-DICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
1,2-DICHLOROETHANE	UG/L	0.31 J	0.35 J	<1.0	<1.0
1,1-DICHLOROETHENE	UG/L	<1.0	<1.0	<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	<0.50	<0.50	<0.50	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50	<0.50	<0.50	<0.50
1,2-DICHLOROPROPANE	UG/L	<1.0	<1.0	<1.0	<1.0
CIS-1,3-DICHLOROPROPENE	UG/L	<1.0	<1.0	<1.0	<1.0
TRANS- 1,3-DICHLOROPROPENE	UG/L	<1.0	<1.0	<1.0	<1.0
ETHYLBENZENE	UG/L	<1.0	<1.0	<1.0	<1.0
2-HEXANONE	UG/L	<5.0	<5.0	5.0	<5.0
METHYLENE CHLORIDE	UG/L	<1.0	<1.0	<1.0	<1.0
4-METHYL-2-PENTANO-,E (MIBK)	UG/L	<5.0	<5.0	5.0	<5.0
STYRENE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1,2,2-TETRACHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
TETRACHLOROETHYLENE(PCE)	UG/L	<1.0	<1.0	<1.0	<1.0
TOLUENE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1,2-TRICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	<1.0	<1.0	<1.0	<1.0
VINYL CHLORIDE	UG/L	<2.0	<2.0	<2.0	<2.0
XYLENES, TOTAL	UG/L	<1.0	<1.0	<1.0	<1.0
	UG/L				
INORGANICS	UG/L				
ANTIMONY	UG/L	<2.0 UJ	<2.0 UJ	<2.0	<2.0
ARSENIC	UG/L	1.2 J	3.2 J	0.54 J	3.0 J
BARIUM	MG/L	0.0482	0.0286	0.0152	0.0158
BERYLLIUM	MG/L	<0.005	<0.005	<0.005	<0.005
CADMIUM	UG/L	<1.0 UJ	<1.0 UJ	<1.0	0.14 J
CHROMIUM	MG/L	<0.010	<0.010	<0.010	<0.010
COBALT	MG/L	<0.010	<0.010	<0.010	<0.010
COOPER	MG/L	<0.010	<0.010	<0.010	0.0021 J
LEAD	MG/L	0.00010 J	0.00081 J	0.000089 J	0.00010 J
MANGANESE	MG/L	0.0425	<0.010 UJ	0.54	4.8
NICKLE	MG/L	<0.040	<0.040	<0.040	0.0111 J
SILVER	MG/L	<0.010	<0.010	<0.010	<0.010
THALLIUM	UG/L	<1.0 UJ	<1.0 UJ	<1.0 UJ	<1.0 UJ
VANADIUM	MG/L	<0.010	<0.010	<0.010	<0.010
ZINC	MG/L	<0.020 UJ	<0.020 J	<0.020 J	<0.020 UJ
	UG/L				
WATER QUALITY					
CHLORIDE (AS CL)	MG/L	27.2	25.3	42.6	40.8
SULFATE (AS SO4)	MG/L	104	876	324	2810
TOTAL DISSOLVED SOLIDS	MG/L	421	1800	987	4330

Attachment D
Summary of Analytical Results- Soil Samples
OU-6 LTO/LTM July 1999 Sampling event
Ellsworth Air Force Base

ANALYTES	UNITS	SD0601 JUL 1999	S D0601-DUP JUL 1999
VOCS			
ACETONE:	UG/KG	14 J	10 J
BENZENE	UG/KG	<8.1	<7.9
BROMODICHLOROMETHANE	UG/KG	<8.1	<7.9
BROMOFORM	UG/KG	<8.1	<7.9
BROMOMETHANE	UG/KG	<16	<16
2-BUTANONE(MEK)			
CARBON DISULFIDE	UG/KG	<8.1	<7.9
CARBON TETRACI ILORI DE	UG/KG	<8.1	<7.9
CHLOROBENZENE	UG/KG	<8.1	<7.9
CHLOROETHANE	UG/KG	<16	<16
CHLOROFORM	UG/KG	<8.1	<7.9
CHLOROMETHANE	UG/KG	<16	<16
DI BROMOCHLOROMETHANE	UG/KG	<8.1	<7.9
1, 1 -DICHLOROETHANE	UG/KG	<8.1	<7.9
1,2-DICHLOROETHANE	UG/KG .	<8.1	<7.9
1,1-DICHLOROETH ENE	UG/KG	<8.1	<7.9
CIS-1,2-DICHLOROETHYLENE	UG/KG	<4.0	<3.9
TRANS- 1,2-DICI ILOROETHENE	UG/KG	<4.0	<3.9
I,2-DICI ILOROPROPANE	UG/KG	<8.1	<7.9
CIS-1,3-DICHLOROPROPENE	UG/KG	<8.1	<7.9
TRANS- 1,3-DICHLOROPROPENE	UG/KG	<8.1	<7.9
ETHYLBENZENE	UG/KG	<8.1	<7.9
2-1-HEXANONE	UG/KG	<32	<32
METLEYLENE CHLORIDE	UG/KG	<8.1 UJ	<7.9 UJ
4-METHYL-2-PENTANONE (MIBK)	UG/KG	<32	<32
STYRENE	UG/KG	<8.1	<7.9
1 ,1, ,2,2-TETRACH LOROETHAN E	UG/KG	<8.1	<7.9
TETRACHLOROETHYLENE (PCE)	UG/KG	<8.1	<7.9
TOLUENE	UG/KG	<8.1	<7.9
1,1,1 TRICHLOROETHANE	UG/KG	<8.1	<79
1,1,2-TRICHLOROETHANE	UG/KG	<8.1	<7.9
TRICHLOROETHYLENE (TCE)	UG/KG	<8.1	<7.9
VINYL CHLORIDE	UG/KG	<16	<16
XYLENES TOTAL	UG/KG	<8.1	<7.9

Attachment D
Summary of Analytical Results- Soil Samples
OU-6 LTO/LTM July 1999 Sampling event
Ellsworth Air Force Base

ANALYTES	UNITS	SD0601 JUL 1999	S D0601-DUP JUL 1999
PAHS			
ACENAPHTHENE	UG/KG	<320	350
ACENAPHTHYLENE	UG/KG	<320	<320
ANTHRACENE	UG/KG	97	93
BENZO(A)ANTHRACENE	UG/KG	180	69
BENZO(A)PYRENE	UG/KG	420 J	520 J
BENZO(B)FLUROANTHENE	UG/KG	610 J	550 J
BENZO(GHI)PERYLENE	UG/KG	680 J	850 J
BENZO(K)FLUROANTHENE	UG/KG	190	210
CHRYSENE	UG/KG	430	650
DIBENZO(A,H) ANTHRACENE	UG/KG	940 J	1300 J
FLUROANTHENE	UG/KG	1000 J	1100 J
FLUORENE	UG/KG	<65	<63
INDENO (1,2,3-CD) PYRENE	UG/KG	<65	<63
NAPHTHALENE	UG/KG	<320	<320
PHENANTHRENE	UG/KG	530	620
PYRENE	UG/KG	1200 J	1200 J
WATER QUALITY PARAMETERS			
pH	UNITS	7.9	7.9

Attachment D
Summary of Analytical Results
OU-7LTO/LTM July 1999 Sampling event
Ellsworth Air Force Base

		MW930701	MW980702	MW980701	MW980702
ANALYTES	**UNITS**	**APR 2000**	**APR 2000**	**APR 2000**	**APR 2000**
VOCS					
ACETONE	UG/L	R	R	R	R
BENZENE	UG/L	<1.0	<1.0	<1.0	<1.0
BROMODICHLOROMETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
BROMOFORM	UG/L	<1.0	<1.0	<1.0	<1.0
BROMOMETHANE	UG/L	<2.0	<2.0	<2.0	<2.0
2-BUTANONE (MEK)	UG/L	R	R	R	R
CARBON DISULFIDE	UG/L	<1.0	<1.0	<1.0	<1.0
CARBON TETRACHLORIDE	UG/L	<1.0	<1.0	<1.0	<1.0
CHLOROBENZENE	UG/L	<1.0	<1.0	<1.0	0.21 J
CHLOROETHANE	UG/L	<2.0	<2.0	<2.0	<2.0
CHLOROFORM	UG/L	<1.0	<1.0	0.37 J	<1.0
CHLOROMETHANE	UG/L	<2.0	<2.0	<2.0	<2.0
DIBROMOCHLOROMETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1-DICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
1,2-DICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1-DICHLOROETHENE	UG/L	<1.0	<1.0	<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	<0.50	<0.50	<0.50	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50	<0.50	<0.50	<0.50
1,2-DICHLOROPROPANE	UG/L	<1.0	<1.0	<1.0	<1.0
CIS-1,3-DICHLOROPROPENE	UG/L	<1.0	<1.0	<1.0	<1.0
TRANS- 1,3-DICHLOROPROPENE	UG/L	<1.0	<1.0	<1.0	<1.0
ETHYLBENZENE	UG/L	<1.0	<1.0	<1.0	<1.0
2-HEXANONE	UG/L	<5.0	<5.0	5	<5.0
METHYLENE CHLORIDE	UG/L	<1.0	<1.0	<1.0	<1.0
4-METHYL-2-PENTANOE (MIBK)	UG/L	<5.0	<5.0	5	<5.0
STYRENE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1,2,2-TETRACHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
TETRACHLOROETHYLENE(PCE)	UG/L	<1.0	<1.0	<1.0	<1.0
TOLUENE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
1,1,2-TRICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	<1.0	28	33	4.2
VINYL CHLORIDE	UG/L	<2.0	<2.0	<2.0	<2.0
XYLENES, TOTAL	UG/L	<1.0	<1.0	<1.0	<1.0

Attachment D
Summary of Analytical Results- Ground Water and Surface Water
OU-8LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW930810	MW930810-
ANALYTES	**UNITS**	**APR 2000**	**APR 2000**
VOCS			
ACETONE	UG/L	R	R
BENZENE	UG/L	<1.0	<1.0
BROMODICHLOROMETHANE	UG/L	<1.0	<1.0
BROMOFORM	UG/L	<1.0	<1.0
BROMOMETHANE	UG/L	<2.0	<2.0
2-BUTANONE (MEK)	UG/L	R	R
CARBON DISULFIDE	UG/L	<1.0	<1.0
CARBON TETRACHLORIDE	UG/L	<1.0	<1.0
CHLOROBENZENE	UG/L	<1.0	<1.0
CHLOROETHANE	UG/L	<2.0	<2.0
CHLOROFORM	UG/L	<1.0	<1.0
CHLOROMETHANE	UG/L	<2.0	<2.0
DIBROMOCHLOROMETHANE	UG/L	<1.0	<1.0
1,1-DICHLOROETHANE	UG/L	<1.0	<1.0
1,2-DICHLOROETHANE	UG/L	<1.0	<1.0
1,1-DICHLOROETHENE	UG/L	<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	<0.50	<0.50
TRANS-1.2-DICHLOROETHENE	UG/L	<0.50	<0.50
1,2-DICHLOROPROPANE	UG/L	<1.0	<1.0
CIS-1.3-DICHLOROPROPENE	UG/L	<1.0	<1.0
TRANS- 1,3-DICHLOROPROPENE	UG/L	<1.0	<1.0
ETHYLBENZENE	UG/L	<1.0	<1.0
2-HEXANONE	UG/L	<5.0	<5.0
METHYLENE CHLORIDE	UG/L	<1.0 UJ	<1.0 UJ
4-METHYL-2-PENTANOE (MIBK)	UG/L	<5.0	<5.0
STYRENE	UG/L	<1.0	<1.0
1,1,2,2-TETRACHLOROETHANE	UG/L	<1.0	<1.0
TETRACHLOROETHYLENE(PCE)	UG/L	<1.0	<1.0
TOLUENE	UG/L	<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0	<1.0
1.1,2-TRICHLOROETHANE	UG/L	<1.0	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	<1.0	28
VINYL CHLORIDE	UG/L	<2.0	<2.0
XYLENES. TOTAL	UG/L	<1.0	<1.0
EXPLOSIVES			
2-AMINO-4,6 DINITROTOLUENE	UG/L	<0.10	<0.10
4-AMINO-2,6 DINITROTOLUENE	UG/L	<0.10 UJ	<0.10 UJ
1,3-DINITROBENZENE	UG/L	<0.10	<0.10
2,4-DINITROTOLUENE	UG/L	<0.10	<0.10
26-DINITROTOLUENE	UG/L	<0.25	<0.25
HMX	UG/L	<0.25	<0.25
NITROBENZENE	UG/L	<0.25	<0.25
2-NITROTOLUENE	UG/L	<0.25	<0.25
3-NITROTOLUENE	UG/L	<0.25	<0.25
4-NITROTOLUENE	UG/L	<0.25	<0.25
RDX	UG/L	<0.25	<0.25
TETRYL	UG/L	<0.50	<0.50
1,3,5-TRINITROBENZENE	UG/L	<0.25	<0.25
2,4,6-TRINITROBENZENE	UG/L	<0.10	<0.10

Attachment D
Summary of Analytical Results
BG04/BG05 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW93BG04	MW93BG05	MW941144	MW941145	MW941147	MW941148	MW941151	MW96BG0402	MW96BG0403	MW96BG405	MW96BG0408
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
VOCS												
1,1 DICHLOROETHANE	UG/L	<2.5	0.20 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	1.6	0.20 J	0.31 J	0.16 J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
TRANS-1,2-DICHLOROETHANE	UG/L	0.75	<0.50	0.16 J	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
TETRACHLOROETHYLENE(PCE)	UG/L	<2.5	0.27 J	<1.0	9.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<2.5	2.3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
TRICHLOROETHANE	UG/L	110	5.2	34	21	<1.0	1.5	<1.0	0.48 J	0.32 J	1.1	14
VINYL CHLORIDE		<5.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

Attachment D
Summary of Analytical Results
BG04/BG05 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW96BG0411	MW96BG0411-DUP	MW96BG0419	MW96BG0420	MW96BG0422	MW96BG0425	MW96BG0427	MW972407	MW972408	MW97BG0401
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
VOCS											
1,1-DICHLOROETHANE	UG/L	<1.0	<1.0	0.36 J	0.30 J	0.46 J	<1.0	0.38 J	<1.0	0.13 J	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	<0.50	<0.50	0.21 J	0.38 J	0.19 J	<0.50	0.14 J	<0.50	0.15 J	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
TETRACHLOROETHYLENE (PCE)	UG/L	<1.0	<1.0	0.47 J	0.78 J	0.95 J	<1.0	0.83 J	<1.0	1.7	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0	<1.0	4.2	3.1	3.6	<1.0	2.4	<1.0	0.52 J	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	15	14	8.9	14	11	17	8.6	0.66 J	11	16
VINYL CHLORIDE	UG/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2	<2.0	<2.0	<2.0

Attachment D
Summary of Analytical Results
BG04/BG05 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW97BG0503	MW982419	MW982420	MW982421	MW982422	MW98BG0501	MW98BG0501-DUP	MW98BG0502	MW99BG0501
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
VOCS										
1,1 DICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	0.30 J	<0.50	<0.50	<0.50	<0.50	0.95	0.81	<0.50	<0.50
TRANS-1,2-DICHLOROTHENE	UG/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
TETRACHLOROETHYLENE(PCE)	UG/L	6.1	<1.0	<1.0	<1.0	1.1	8.9	8.3	<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0	<1.0	<1.0	<1.0	0.33 J	<1.0	<1.0	<1.0	<1.0
TRICHLORETHYLENE(TCE)	UG/L	8.3	<1.0	<1.0	<1.0	5.1	17 J	16 J	13	13
VINYLCHLORIDE	UG/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2	<2.0	<2.0

Attachment D
Summary of Analytical Results
OU-11 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW930905	MW930906	MW930911	MW930911-	MW932101	MW932102	MW932102-	MW932103	MW941103	MW941103-	MW941107	MW941113	MW941116	MW94111
	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
ANALYTES															
PETROLEUM HYDROCARBONS															
GRO	UG/L	49	<120	34	<26 UJ	<25 UJ	<25	<25	<25 UJ						
DRO	UG/L	<100	<100	<100	<100	<100	<100	<100	<100						
BTEX	UG/L														
BENZENE	UG/L	<0.50	<2.5	1.2	0.99	<0.50	<0.50	<0.50	<0.50						
ETHYLBENZENE	UG/L	<0.50	<2.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50						
TOLUENE	UG/L	<0.50	<2.5	<0.50 UJ	<0.50UJ	<0.50 UJ	<0.50 UJ	<0.50 UJ	<0.50 UJ						
XYLENES, TOTAL	UG/L	<0.52 UJ	<2.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50						
VOCS															
1,1-DICHLOROETHANE	UG/L	0.60 J	<2.0	0.77 J	0.75 J	<1.0	<1.0	<1.0	<1.0	<200	<200	<1.0	<6.7	<2.5	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	4.6	0.91 J	45	40	<0.50	<0.50	<0.50	<0.50	<100	<100	<0.50	9.4	43	3.9
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50	0.32 J	1.3	1.1	<0.50	<0.50	<0.50	<0.50	<100	<100	<0.50	<3.3	77	0.28 J
TETRACHLOROETHYLENE(PCE	UG/L	0.24 J	0.61 J	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<200	<200	<1.0	<6.7	<2.5	<1.0
1,1,1-TRICHLOROETHANE	UG/L	<1.0	0.46 J	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<200	<200	<1.0	<6.7	<2.5	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	2.2	120	1.5	1.3 J	<1.0	<1.0	<1.0	<1.0	6300	6000	1.3	240	13	<1.0
VINYL CHLORIDE	UG/L	<2.0	<4.0	<2.0	<4.0	<2.0	<2.0	<2.0	<2.0	<400	<400	<2.0	<13	<5.0	<2.0

Attachment D
Summary of Analytical Results
OU-11 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW941120	MW941127	MW941140	MW941142	MW941143	MW95FRA0101	MW95FRA0102	MW97SD02	MW97SD5001	MW97SDP1101	MW97SDP1102	MW97SD02
	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
ANALYTES													
PETROLEUM HYDROCARBONS													
GRO	UG/L	<29 UJ		<25	<25 UJ		<25	120	8.9 J				<25 UJ
DRO	UG/L	<100		<100	<100		<100	<100	<100				<100
BTEX	UG/L												
BENZENE	UG/L	0.24 J		<0.50	<0.50		<0.50	<0.50	<0.50				<0.50
ETHYLBENZENE	UG/L	<0.50 UJ		<0.50	<0.50		<0.50	<0.50	<0.50				<0.50
TOLUENE	UG/L	<0.50 UJ		<0.50 UJ	<0.50 UJ		0.092 J	0.34 J	0.12 J				<0.50 UJ
XYLENES, TOTAL	UG/L	<0.50 UJ		<0.50	<0.50		<0.50	<0.50	<0.50				<0.50
VOCS													
1,1-DICHLOROETHANE	UG/L	0.74 J	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L	26	14	<0.50	<0.50	0.22 J	<0.50	0.14 J	<0.50	<0.50	0.26 J	<0.50	<0.50
TRANS-1,2-DICHLOROETHENE	UG/L	15	<5.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
TETRACHLOROETHYLENE(PCE)	UG/L	<1.0	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-TRICHLOROETHANE	UG/L	0.72 J	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
TRICHLOROETHYLENE (TCE)	UG/L	35	540	<1.0	<1.0	1.6	1.8	<1.0	<1.0	0.35 J	24	<1.0	<1.0
VINYL CHLORIDE	UG/L	<2.0	<20	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

Attachment D
Summary of Analytical Results
FRA LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW89CP11	MW89CP12	MW89CP12-DUP	MW930902	MW930903	MW930907	MW932105	MW93CP04	MW93CP11	MW95FRA0101
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000	APR 2000
PETROLEUM HYDROCARBONS											
GRO	UG/L	3200 J	3700	3100 J	130	<25	320	<25	<25 UJ	83 J	<25
DRO	UG/L	700	1600	1400	<100	<100	<100	<100	<100	<100	<100
BTEX											
BENZENE	UG/L	440 J	41 J	2.2 J	0.098 J	<0.50	0.58	<0.50	<0.50	50	<0.50
ETHYLBENZENE	UG/L	59 J	210	180 J	<0.50	<0.50	<0.50	<0.50	<0.50 UJ	<2.5	<0.50
TOLUENE	UG/L	<12 UJ	<50	<5.5 UJ	1.3	<0.50 UJ	2.1	<0.50 UJ	<0.50 UJ	<2.5 UJ	<0.50 UJ
XYLENES, TOTAL	UG/L	330 J	400	350 J	<0.50	<0.50	<1.2 UJ	<0.50	<0.54 UJ	<2.5	<0.50
VOCS											
1,1-DICHLOROETHANE	UG/L										<1.0
CIS-1,2-DICHLOROETHYLENE	UG/L										<0.50
TRANS-1,2-DICHLOROETHENE	UG/L										<0.50
TETRACHLOROETHYLENE(PCE)	UG/L										<1.0
1,1,1-TRICHLOROETHANE	UG/L										<1.0
TRICHLOROETHYLENE (TCE)	UG/L										1.8
VINYL CHLORIDE	UG/L										<2.0

Attachment D
Summary of Analytical Results
FRA LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW95FRA0102	MW95FRA0401	MW95FRA0402
ANALYTES	UNITS	APR 2000	APR 2000	APR 2000
PETROLEUM HYDROCARBONS				
GRO	UG/L	120	240 J	170
DRO	UG/L	<100	180	110
BTEX				
BENZENE	UG/L	<0.50	0.54 J	26
ETHYLBENZENE	UG/L	<0.50	15 J	4.4
TOLUENE	UG/L	<0.50 UJ	<0.50	<0.50
XYLENES, TOTAL	UG/L	<0.50	8.2 J	<0.58 UJ
VOCS				
1,1-DICHLOROETHANE	UG/L	<1.0		
CIS-1,2-DICHLOROETHYLENE	UG/L	0.14 J		
TRANS-1,2-DICHLOROETHENE	UG/L	<0.50		
TETRACHLOROETHYLENE(PCE)	UG/L	<1.0		
1,1,1-TRICHLOROETHANE	UG/L	<1.0		
TRICHLOROETHYLENE (TCE)	UG/L	<1.0		
VINYL CHLORIDE	UG/L	<2.0		

Attachment D
Summary of Analytical Results
OU-12 LTO/LTM April 2000 Sampling Event
Ellsworth Air Force Base

		MW931201	MW931201-DUP
ANALYTES	UNITS	APR 2000	APR 2000
VOCS			
ACETONE	UG/L	R	
BENZENE	UG/L	<1.0	
BROMODICHLOROMETHANE	UG/L	<1.0	
BROMOFORM	UG/L	<1.0	
BROMOMETHANE	UG/L	<2.0	
2-BUTANONE (MEK)	UG/L	R	
CARBON DISULFIDE	UG/L	<1.0	
CARBON TETRACHLORIDE	UG/L	<1.0	
CHLOROBENZENE	UG/L	<1.0	
CHLOROETHANE	UG/L	<2.0	
CHLOROFORM	UG/L	<1.0	
CHLOROMETHANE	UG/L	<2.0	
DIBROMOCHLOROMETHANE	UG/L	<1.0	
1,1-DICHLOROETHANE	UG/L	<1.0	
1,2-DICHLOROETHANE	UG/L	<1.0	
1,1-DICHLOROETHENE	UG/L	0.65 J	
CIS-1,2-DICHLOROETHYLENE	UG/L	9.3	
TRANS-1.2-DICHLOROETHENE	UG/L	<0.50	
1,2-DICHLOROPROPANE	UG/L	<1.0	
CIS-1.3-DICHLOROPROPENE	UG/L	<1.0	
TRANS-1,3-DICHLOROPROPENE	UG/L	<1.0	
ETHYLBENZENE	UG/L	<1.0	
2-HEXANONE	UG/L	<5.0	
METHYLENE CHLORIDE	UG/L	<1.0	
4-METHYL-2-PENTANONE (MIBK)	UG/L	<5.0	
STYRENE	UG/L	<1.0	
1,1,2,2-TETRACHLOROETHANE	UG/L	<1.0	
TETRACHLOROETHYLENE(PCE)	UG/L	0.25 J	
TOLUENE	UG/L	<1.0	
1,1,1-TRICHLOROETHANE	UG/L	<1.0	
1.1,2-TRICHLOROETHANE	UG/L	<1.0	
TRICHLOROETHYLENE (TCE)	UG/L	9.7	
VINYL CHLORIDE	UG/L	<2.0	
XYLENES, TOTAL	UG/L	<1.0	
	UG/L		
PAHS	UG/L		
ACENAPHTHENE	UG/L	<1.0	<1.0
ACENAPHTHYLENE	UG/L	<1.0	<1.0
ANTHRACENE	UG/L	<0.10	<0.10
BENZO(A)ANTHRACENE	UG/L	<0.10	<0.10
BENZO(A)PYRENE	UG/L	<0.10	<0.10
BENZO(B)FLUORANTHENE	UG/L	<0.10	<0.10
BENZO(G,H,I)PERYLENE	UG/L	<0.20	<0.20
BENZO(K)FLUORANTHENE	UG/L	<0.10	<0.10
CHRYSENE	UG/L	<0.20	<0.20
DIBENZ(A,H)ANTHRACENE	UG/L	<0.20	<0.20
FLUORANTHENE	UG/L	<0.20	<0.20
FLUORENE	UG/L	<0.20	<0.20
INDENO(1,2,3-C,D)PYRENE	UG/L	<0.20	<0.20
NAPTHALENE	UG/L	<1.0	<1.0
PHENANTHRENE	UG/L	<0.20	0.063 J
PYRENE	UG/L	<0.20	<0.20
WATER QUALITY PARAMETERS			
TOTAL DISSOLVED SOLIDS	MG/L	1200	
CHLORIDE (AS CL)	MG/L	35.0 J	
SULFATE (AS SO4)	MG/L	513 J	

APPENDIX B

PUBLIC NOTICE OF 5-YEAR REVIEW

ADVERTISEMENT IN RAPID CITY JOURNAL
JUNE 6, 7, AND 8, 2000

5-Year Review & Environmental Community Relations Plan Update

The Ellsworth AFB Environmental Restoration Team asks ...

- *Do you feel our environmental cleanup efforts are effective?*
- *Do you have any concerns about our cleanup efforts?*
- *How can we better inform you about our cleanup efforts?*

We're conducting a 5-Year Review of the environmental cleanup remedies that are currently in place at the base to ensure they're still protecting people and the environment.

To do this work, we need to hear from local landowners and residents who have been directly impacted by the base's environmental cleanup efforts, contractors involved in the cleanup work, local officials and any other interested parties who can shed light on the effectiveness of the selected remedies.

We're also updating our Environmental Community Relations Plan. Community input will help us determine if any gaps exist in our public outreach and communication programs, so improvements can be made as needed.

Public input will be incorporated into separate reports for each of these efforts, and an announcement will be made when they're available for public viewing.

Interviews will be conducted between June 26 and June 28. We can do them by phone or in person. If you're interested in participating, please call 2nd Lt Kellie Quinn at the 28th Bomb Wing Public Affairs Office (605) 385-5068.

Call us by June 16 to set up an interview time!
We'd like to hear from you!

APPENDIX C

COPY OF BASE CONTINUING ORDER

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 28TH BOMB WING (ACC)
ELLSWORTH AIR FORCE BASE, SOUTH DAKOTA

30 JUN 2000

MEMORANDUM FOR DISTRIBUTION F & T

FROM: 28 BW/CC

SUBJECT: Land Use Restrictions at Environmental Restoration Sites

1. In 1990, Ellsworth AFB was placed on the Environmental Protection Agency's (EPA) National Priority List because of soil and ground water contamination caused by past work practices. In 1992, a Federal Facilities Agreement was signed with the EPA and State Department of Environmental and Natural Resources that divided the base in to 12 operable units.

2. The attachments summarize the existing restrictions and hazards on each of the 12 operable units on base. A copy of the original Continuing Order with a map indicating the location of each operable unit on base is at attachment 1. Attachment 2 summarizes the specific restrictions of each operable unit. Attachment 3 delineates the requirement for construction waivers at all restoration program sites. Any violation of these restrictions subjects the base to fines and stipulated penalties.

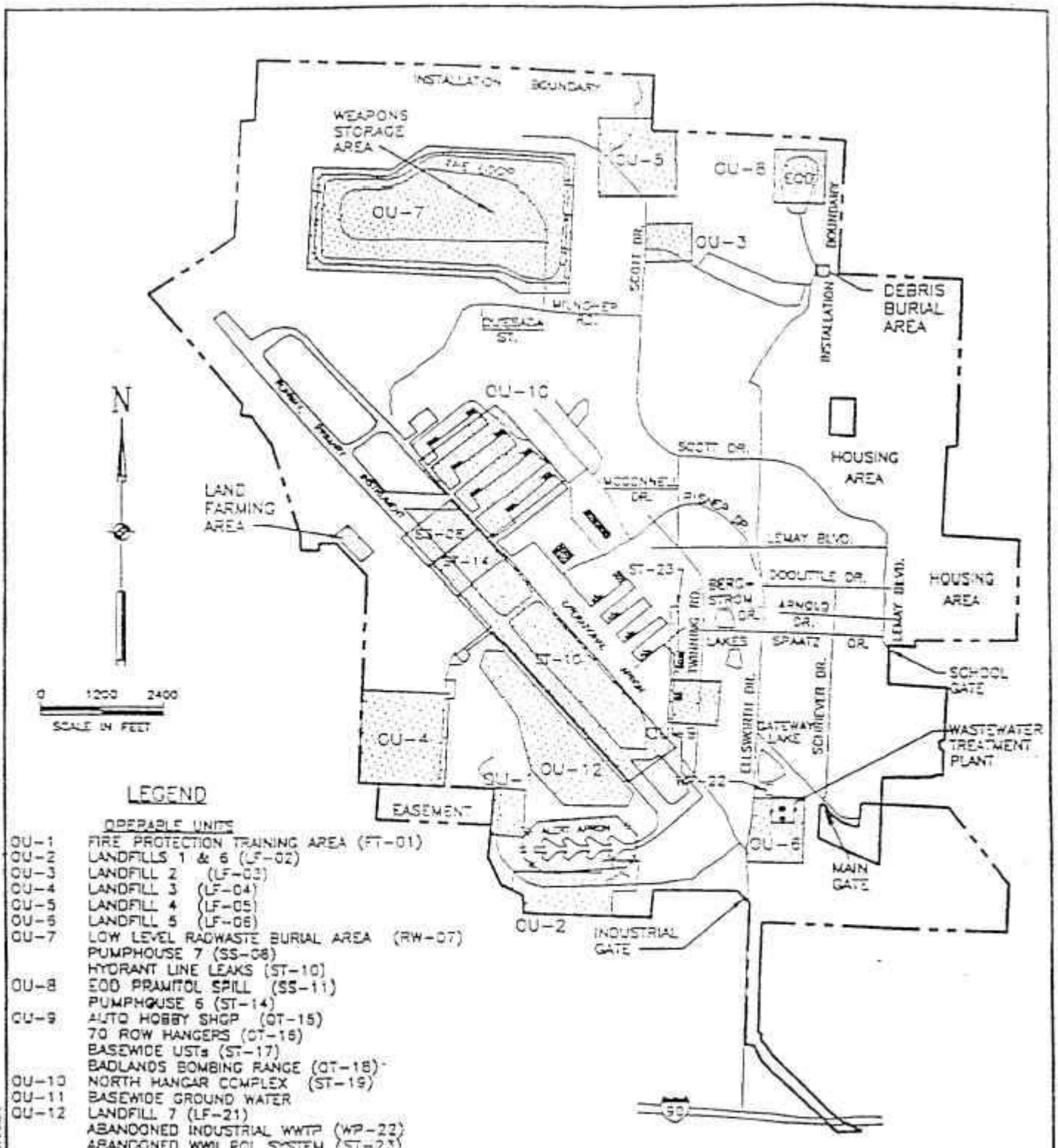
3. Please be advised that the attached order continues to be in effect and must be strictly adhered to by all Ellsworth AFB personnel and contractors.

4. If there are any questions, please contact Mr. Dell Petersen at extension 5-2675.

EDWARD A. RICE JR., Colonel, USAF
Commander

Attachments:
1. 28 BW/CV Memo, 27 Aug 97
2. Operating Unit Restrictions
3. Construction Waiver Memo, 6 Dec 96
4. OU8 Action Plan

Global Power For America



LEGEND

OPERABLE UNITS

OU-1	FIRE PROTECTION TRAINING AREA (FT-01)
OU-2	LANDFILLS 1 & 6 (LF-02)
OU-3	LANDFILL 2 (LF-03)
OU-4	LANDFILL 3 (LF-04)
OU-5	LANDFILL 4 (LF-05)
OU-6	LANDFILL 5 (LF-06)
OU-7	LOW LEVEL RADWASTE BURIAL AREA (RW-07)
	PUMPHOUSE 7 (SS-08)
	HYDRANT LINE LEAKS (ST-10)
OU-8	EOD PRAMITOL SPILL (SS-11)
	PUMPHOUSE 6 (ST-14)
OU-9	AUTO HOBBY SHOP (OT-15)
	70 ROW HANGERS (OT-16)
	BASEWIDE USTs (ST-17)
	BADLANDS BOMBING RANGE (OT-18)
OU-10	NORTH HANGAR COMPLEX (ST-19)
OU-11	BASEWIDE GROUND WATER
OU-12	LANDFILL 7 (LF-21)
	ABANDONED INDUSTRIAL WWTP (WP-22)
	ABANDONED WWII POL SYSTEM (ST-23)

ELLSWORTH AIR FORCE BASE

ELLSWORTH AFB
RAPID CITY, SOUTH DAKOTA

SITE LOCATION MAP

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE:
		STAFF		AS SHOWN	OCT 95	60378.95	3-1

DRAWING NAME: F:\HORIZONS\NEW\MAPS\DOWELL1
DATE:06/21/1995 TIME:16:31

Pg 2 of 2
NTCN 1

OU-3

The selected alternative, capping, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation, over the landfill area
- A pre-design study to examine the need for landfill gas control measures
- Institutional controls for the landfill area
- Long-term ground-water monitoring, and long-term maintenance of soil cover

OU-4

The selected alternative for the landfill, soil cover, includes the following major components:

- Institutional controls for the landfill area
- Placing a soil cover capable of sustaining perennial vegetation over the landfill area
- Landfill gas monitoring and passive collection system, as necessary
- Long-term monitoring and maintenance

The selected alternative for the ground water, pump and treat, includes the following major components:

- Continued operations of the interim remedial action (IRA) which consists of removal and treatment of contaminated ground water
- Installation of recovery trenches and/or additional extraction wells to be added to the existing IRA ground-water recover system.
- Treatment of removed ground water at the treatment plant built for the IRA
- Discharge of treated ground water to a surface water drainage, to the Base wastewater treatment plant, or by underground injection

OU-5

The selected alternative, Covering, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the landfill are
- Institutional controls for the landfill area
- Long-term ground-water monitoring; and long-term maintenance of soil cover

OU-6

The selected alternative, capping, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the landfill area
- Modification of storm-water discharge point and drainage

portion of OU-9. Remediation of other areas where soil and/or ground water is contaminated by petroleum will be performed in compliance with State of South Dakota regulations.

pg 2 of 5
ATCH 2

OU-10

Based on the finding of no unacceptable risk to human health and the environment, remediation is not warranted for OU-10. Remediation of soils and/or ground water contaminated by petroleum will be performed under the State of South Dakota regulations.

OU-11

OU-11 has been divided into two areas. Area 1 is the South Docks Study Area, and Area 2 is the BG04 and BG05 Study Areas.

The selected alternative for Area 1, Ground-Water Extraction and Treatment with Containment, includes the following major components:

- Ground-water removal and treatment in the South Docks Study Area
- On-base containment of ground water containing contaminants at concentrations above Federal Maximum Contaminant Levels (MCLs) and State of South Dakota Ground-Water Quality Standards.
- Institutional controls and long-term monitoring

The selected alternative Area 2, Ground-Water Containment/Extraction and Treatment, includes the following major components:

- Ground-water removal and treatment along the northeast base boundary and at areas of high contaminant concentrations on base
- Natural attenuation of low contaminant concentration areas, primarily off-base
- Alternative water supply to residents affected by contamination coming from the base
- Additional investigation to determine the eastern extent of off-base ground-water contamination
- Institutional controls and long-term monitoring

OU-12

The selected alternative, capping, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the hardfill area
- Pre-design study to identify the source of methane and examine the need for hardfill gas control measures, and evaluate the need for erosion control measures along the stream adjacent to the hardfill areas
- Institutional controls for the hardfill areas
- Long-term monitoring

pg. 4 of 5
MCN 2

6L

DEPARTMENT OF THE AIR FORCE

AIR COMBAT COMMAND CIVIL ENGINEER SQUADRON
LANGLEY AIR FORCE SASE, VIRGINIA

06 DEC 1996

MEMORANDUM FOR DISTRIBUTION

FROM: HQ ACC/CEV
129 Andrews Street Ste 102
Langley AFB VA 23665

SUBJECT: Construction Waiver Requests for Installation Restoration Program (IRP) Sites

1. Reference: Air Force Instruction (AFI) 32-1021, 12 May 94, Planning and Programming of Facility Construction Projects.

2. This letter is to provide clarification of the ACC policy regarding construction on IRP sites. Even though AFI 32-1021 primarily addresses MILCON projects, the waiver described below should be used for any type of construction activity on or near IRP sites. The warner process is designed to ensure risks to human health and the environment are considered before the start of construction projects.

3. A problem developed recently when a request for waiver was approved for an FY96 MILCON project based on the assumption the site should be remediated before the actual start of construction. This conditional approval gave the construction agency the go-ahead to continue design and contracting actions. unfortunately the MILCON project was moved forward to FY95, while the IRP project slipped a year. The result was the MILCON was ready to go out on the street for bids and the IRP cleanup was not under contract (in fact, the Remedial Investigation/Feasibility Study (RI/FS) had not started).

4. In another recent instance, a chain link fence was constructed across an IRP site. The fence must now be removed to accomplish an IRP remedial action. The project was net coordinated through the environmental flight.

5. Written waiver for construction requests on an IRP site should be sent from the Base Civil Engineer to HQ ACC/CEV, copy ACC CES/ES. Waiver requests should be submitted for closed IRP sites as well as active sites. The waiver request should include the following information:

a. description of the proposed construction.

b. The IRP site number.

c. The expected impact of the proposed construction on the site.

d. Information regarding whether or not regulatory agencies have been contacted regarding the proposed construction.

OU-8 ACTION PLAN

1. **Strategy:** To restore the Operable Unit (OU) 8 site quickly to its original configuration under the approval of South Dakota Department of Environment and Natural Resources and the Environmental Protection Agency (EPA), ensuring safety to the site and personnel. To implement a program that will ensure all Restoration sites on base comply with the Record of Decision (ROD) as signed by the Wing Commander.

2. **Status:** On 26 August 99, 16 pieces of dynamite that were exuding nitroglycerin were destroyed on the old Explosives Ordnance Disposal (EOD) Range, creating 2 pits approximately 8 feet in diameter, and 3 feet deep. Later, two more emergency detonations occurred, on 26 Aug 99 to destroy additional leaking dynamite, and on 28 Sep 99, a ground burst projectile simulator and an M-18 smoke grenade that dud fired during a training exercise. The detonations damaged the landfill cap that is part of OU8. Late on 5 Oct 99, CEV identified the craters and immediately began notifications up the chain of command. ACC, EPA and state officials were notified on 6 Oct 99.

3. **Action Items:**

Repair Site

3.1 Obtain funding and contract to restore site
3.2 Develop sampling plan and repair plan
3.3 Collect samples of site and restore to original design condition

Improvement Process

3.4 Construct fence around OU-8 boundary, limiting all future access
  3.4.1 Survey fence location
  3.4.2 Obtain digging permit
  3.4.3 Submit work request
  3.4.4 Install fence
3.5 Install signs on OU8 fence similar to those on other OU's that state, "Closed, No Access, Contact 385-2680"
3.6 Preidentify a location on base for emergency disposal of ordnance
3.7 Update EOD Team Chief Checklist to include notification requirements and a map of approved disposal area
3.8 Update CEV Spill Binder to include checklist that identifies notification requirements and a map of approved disposal area
3.9 Redistribute copy of standing order
  3.9.1 Redistribute original copy of standing order with cover letter by Col P.
  3.9.2 Redistribute standing order with updated policy letters with every new WG/CC
3.10 Provide training to a1128 CES Flight Chiefs, 28 CES/CEO Superintendents, and 28 CES heavy equipment operators
3.11 Provide awareness training to all "On-Scene Commanders"

ATCH 4

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 28TH BOMB WING (ACC)

ELLSWORTH AIR FORCE BASE, SOUTH DAKOTA

30 JUN 2000

MEMORANDUM FOR DISTRIBUTION F & T

FROM: 28 BW/CC

SUBJECT: Land Use Restrictions at Environmental Restoration Sites

1. In 1990, Ellsworth AFB was placed on the Environmental Protection Agency's (EPA) National Priority List because of soil and ground water contamination caused by past work practices. In 1992, a Federal Facilities Agreement was signed with the EPA and State Department of Environmental and Natural Resources that divided the base in to 12 operable units.

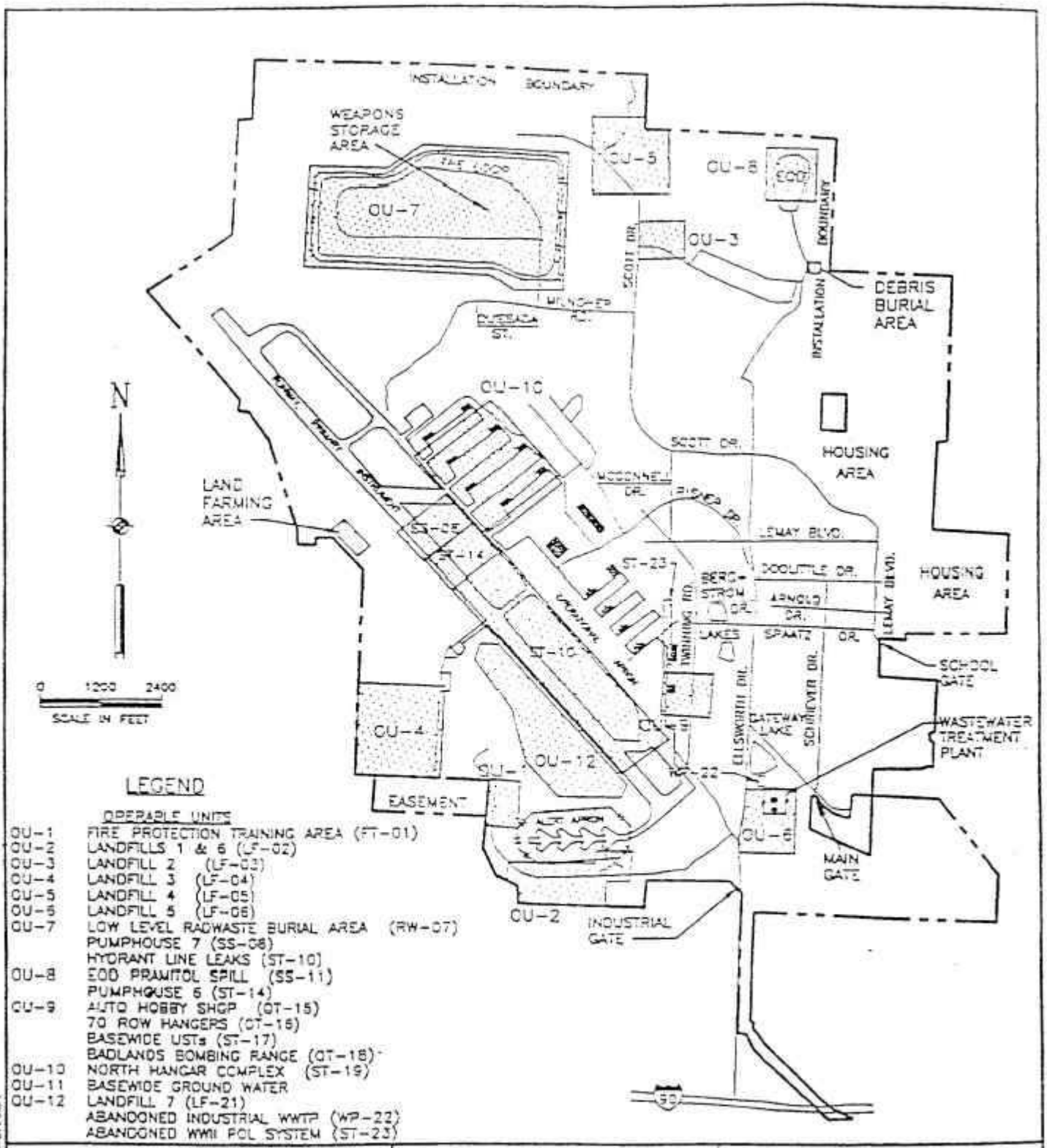
2. The attachments summarize the existing restrictions and hazards on each of the 12 operable units on base. A copy of the original Continuing Order with a map indicating the location of each operable unit on base is at attachment 1. Attachment 2 summarizes the specific restrictions of each operable unit. Attachment 3 delineates the requirement for construction waivers at all restoration program sites. Any violation of these restrictions subjects the base to fines and stipulated penalties.

3. Please be advised that the attached order continues to be in effect and must be strictly adhered to by
all Ellsworth AFB personnel and contractors.

4. If there are any questions, please contact Mr. Dell Petersen at extension 5-2675.

EDWARD A. RICE, JR., Colonel USAF
Commander

Attachments:
1. 28 BW/CV Memo, 27 Aug 97
2. Operating Unit Restrictions
3. Construction Waiver Memo, 6 Dec 96
4. OU8 Action Plan



LEGEND

OPERABLE UNITS

OU-1	FIRE PROTECTION TRAINING AREA (FT-01)
OU-2	LANDFILLS 1 & 6 (LF-02)
OU-3	LANDFILL 2 (LF-03)
OU-4	LANDFILL 3 (LF-04)
OU-5	LANDFILL 4 (LF-05)
OU-6	LANDFILL 5 (LF-06)
OU-7	LOW LEVEL RADWASTE BURIAL AREA (RW-07)
	PUMPHOUSE 7 (SS-08)
	HYDRANT LINE LEAKS (ST-10)
OU-8	EOD PRAMITOL SPILL (SS-11)
	PUMPHOUSE 6 (ST-14)
OU-9	AUTO HOBBY SHOP (OT-15)
	70 ROW HANGERS (OT-16)
	BASEWIDE USTs (ST-17)
	BADLANDS BOMBING RANGE (OT-18)
OU-10	NORTH HANGAR COMPLEX (ST-19)
OU-11	BASEWIDE GROUND WATER
OU-12	LANDFILL 7 (LF-21)
	ABANDONED INDUSTRIAL WWTP (WP-22)
	ABANDONED WWII POL SYSTEM (ST-23)

ELLSWORTH AIR FORCE BASE

ELLSWORTH AFB
RAPID CITY, SOUTH DAKOTA

SITE LOCATION MAP

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
		STAFF		AS SHOWN	OCT 95	60378.95	3-1

DRAWING NAME: F:\HORIZONS\NEW\MAP\DGWELL1
DATE:06/21/1995 TIME:16:31

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ATCH 1

OU-3

The selected alternative, capping, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation, over the landfill area
- A pre-design study to examine the need for landfill gas control measures
- Institutional controls for the landfill area
- Long-term ground-water monitoring, and long-term maintenance of soil cover

OU-4

The selected alternative for the land a. soil cover, includes the following major components:

- Institutional controls for the landfill area
- Placing a soil cover capable of sustaining perennial vegetation over the landfill area
- Landfill gas monitoring and passive collection system. as necessary
- Long-term monitoring and maintenance

The selected alternative for the ground water, pump and treat, includes the following major components:

- Continued operation of the interim remedial action (IRA) which consists of removal and treatment of contaminated ground water
- Installation of recovery trenches and/or additional extraction wells to be added to the existing IRA ground-water recovery system
- Treatment of removed ground water at the treatment plant built for the IRA
- Discharge of treated ground water to a surface water drainage, to the Base wastewater treatment plant, or by underground infection

OU-5

The selected alternative, Covering, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the landfill area
- Institutional controls for the landfill area
- Long-term ground-water monitoring; and, long-term maintenance of soil cover

OU-6

The selected alternative, capping, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the landfill area
- Modification of storm-water discharge point and drainage

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ATCH 2

portion of OU-9 Remediation of other areas where soil and/or ground water is contaminated by petroleum will be performed in compliance with State of South Dakota regulations.

OU-10

Based on the findings of no unacceptable risk to human health and the environment, remediation is not warrranted Ior OU-10. Remediation of soils and; or ground water contaminated by petroleum will be performed under the State of South Dakota regulations.

OU-11

OU-11 has been divided into two areas. Area 1 is the South Docks Study Area, and Area 2 is the BG04 and BG05 Study Areas.

The selected alternative for Area 1, Ground-Water Extraction and Treatment with Containment, includes the following major components:

- Ground-water removal and treatment in the South Docks Study Area
- On-base containment of ground water containing contaminants at concentrations above Federal Maximum Contaminant Levels (MCLs) and State of South Dakota Ground-Water Quality Standards
- Institutional controls and long-term. monitoring

The selected alternative for Area 2, Ground-Water Containment/Extraction and Treatment, includes the following major components:

- Ground-water removal and treatment along the northeast base boundary and at areas of high contaminant concentrations on-base
- Natural attenuation of low contaminant concentration areas, primarily off-base
- Alternative water supply to residents affected by contamination coming from the base
- Additional investigation to determine the eastern extent of off-base ground-water contamination
- Institutional controls and long-term monitoring

OU-12

The selected alternative, capping, includes the following major components:

- Placing a soil cover capable of sustaining perennial vegetation over the hardfill area
- Pre-design study to identify the source of methane and examine the need for hardfill gas control measures, and evaluate the need for erosion control measures along the stream adjacent to the hardfill areas
- Institutional controls for the hardfill areas
- Long-term monitoring

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DEPARTMENT OF THE AIR FORCE
AIR COMBAT COMMAND CIVIL ENGINEER SQUADRON
LANGLEY AIR FORCE SASE, VIRGINIA

MEMORANDUM FOR DISTRIBUTION

06 DEC 1996

FROM: HQ ACC/CEV
129 Andrews Street Ste 102
Langley AFB VA 23665

SUBJECT: Construction Waiver Requests for Installation Restoration Program (IRP) Sites

• Reference: Air Force Instruction (AFI) 32-1021, 12 May 94, Planning and Programming of Facility Construction Projects.

• This letter is to provide clarification of the ACC policy regarding construction on IRP sites. Even though AFI 32-1021 primarily addresses MILCON projects, the waiver described below should be used for any type of construction activity on or near IRP sites. The warner process is designed to ensure risks to human health and the environment are considered before the start of construction projects.

• A problem developed recently when a request for waiver was approved for an FY96 MILCON project based on the assumption the site should be remediated before the actual start of construction. This conditional approval gave the construction agency the go-ahead to continue design and contracting actions. unfortunately the MILCON project was moved forward to FY95, while the IRP project slipped a year. The result was the MILCON was ready to go out on the street for bids and the IRP cleanup was not under contract (in fact, the Remedial Investigation/Feasibility Study (RI/FS) had not started).

• In another recent instance, a chain link fence was constructed across an IRP site. The fence must now be removed to accomplish an IRP remedial action. The project was net coordinated through the environmental flight.

• Written waiver for construction requests on an IRP site should be sent from the Base Civil Engineer to HQ ACC/CEV, copy ACC CES/ES. Waiver requests should be submitted for closed IRP sites as well as active sites. The waiver request should include the following information:

a. description of the proposed construction.

b. The IRP site number.

c. The expected impact of the proposed construction on the site.

d. Information regarding whether or not regulatory agencies have been contacted regarding the proposed construction.

OU-8 ACTION PLAN

1. **Strategy:** To restore the Operable Unit (OU) 8 site quickly to its original configuration under the approval of South Dakota Department of Environment and Natural Resources and the Environmental Protection Agency (EPA), ensuring safety to the site and personnel. To implement a program that will ensure all Restoration sites on base comply with the Record of Decision (ROD) as signed by the Wing Commander.

2. **Status:** On 26 August 99, 16 pieces of dynamite that were exuding nitroglycerin were destroyed on the old Explosives Ordnance Disposal (EOD) Range, creating 2 pits approximately 8 feet in diameter, and 3 feet deep. Later, two more emergency detonations occurred, on 26 Aug 99 to destroy additional leaking dynamite, and on 28 Sep 99, a ground burst projectile simulator and an M-18 smoke grenade that dud fired during a training exercise. The detonations damaged the landfill cap that is part of OU8. Late on 5 Oct 99, CEV identified the craters and immediately began notifications up the chain of command. ACC, EPA and state officials were notified on 6 Oct 99.

3. **Action Items:**

Repair Site

3.1 Obtain funding and contract to restore site
3.2 Develop sampling plan and repair plan
3.3 Collect samples of site and restore to original design condition

Improvement Process

3.4 Construct fence around OU-8 boundary, limiting all future access
  3.4.1 Survey fence location
  3.4.2 Obtain digging permit
  3.4.3 Submit work request
  3.4.4 Install fence
3.5 Install signs on OU8 fence similar to those on other OU's that state, "Closed, No Access, Contact 385-2680"
3.6 Preidentify a location on base for emergency disposal of ordnance
3.7 Update EOD Team Chief Checklist to include notification requirements and a map of approved disposal area
3.8 Update CEV Spill Binder to include checklist that identifies notification requirements and a map of approved disposal area
3.9 Redistribute copy of standing order
  3.9.1 Redistribute original copy of standing order with cover letter by Col P.
  3.9.2 Redistribute standing order with updated policy letters with every new WG/CC
3.10 Provide training to a1128 CES Flight Chiefs, 28 CES/CEO Superintendents, and 28 CES heavy equipment operators
3.11 Provide awareness training to all "On-Scene Commanders"

ATCH 4

APPENDIX D

SUMMARY OF COMMUNITY INTERVIEWS

5-Year Review Interviews

In June 2000, a representative from L.S. EPA, Region VIII, and a representative from the Ellsworth AFB Public Affairs Office interviewed 11 people to get their impressions of how the environmental cleanup work at Ellsworth AFB is going. The interviewees were also asked about their impressions of health risks associated with the various cleanup sites, the effectiveness of Ellsworth AFB's public outreach efforts, and impacts, if any, that construction activities related to the cleanup effort are having on the local community.

The interviewees included the Ellsworth AFB project manager from Earth Tech, the primary contractor for the environmental cleanup work at the base; the community co-chair of the Ellsworth AFB Restoration Advisory Board; the current and former mayors of the City of Box Elder; a professor from the South Dakota School of Mines & Technology; two members of BECOME (Box Elder Citizens on Monitoring the Environment); and four property owners residents directly impacted by contaminated ground water plumes southwest and northeast of the base.

Overall Impressions of the Project. Across the board, interviewee impressions of the project are positive. All interviewees said they feel the Air Force has made every effort to proactively and expeditiously address the environmental problems at Ellsworth AFB.

Property owners/residents impacted by the contaminated ground water plumes southwest and northeast of the base are pleased with the Air Forces efforts to run clean water lines out to their properties/residences. Early on in the project, there were problems with contract workers entering properties without prior coordination with the property owners residents. However, that problem was addressed and corrected as soon as Ellsworth environmental cleanup officials were informed of the problem. Another concern expressed about the water line construction involves post-construction restoration of landscaping on the impacted properties. Ellsworth environmental cleanup officials have made a list of property owner concerns, and arrangements are being made for correcting the landscaping problems (reseeding lawns, restoring condition of drainage ditches. etc.)

Identified Concerns: 1. Inadequate post-construction restoration of off-Base properties following installation of remedial action systems and/or water lines.

Overall Impressions of Health Risks. Three interviewees said they're confident the Air Force is doing a good job of quickly addressing the most significant health risks as they are identified. Health risks and remedial actions these interviewees mentioned include identifying the extent of contaminated ground water plumes and installing treatment systems to remove contaminants; capping of landfills to prevent exposure to and infiltration of landfill contaminants to ground water; removal of low-level radiological waste and removal of buried Chemical Agent Instruction Sets found during construction work at Operable Unit 2.

Two interviewees expressed concerns about environmental problems on the base, particularly in the North and South Docks areas and the old auto hobby shop site. They said it appears the Air Force has focused more attention and resources on contamination that has impacted people beyond the base's boundaries. They want assurances in the form of public information that show the Air Force is putting the same level of attention and resources toward the problems within the base boundaries, particularly in the area of contaminated ground water plumes on base. They also want information on the status of underground storage tank removal actions on the base.

Two other interviewees said they feel that reports of many of the health risks associated with environmental problems at the base are "overblown."

One of these interviewees who has a technical background submitted the following written comment:

"We know that ground water takes a long time to clean up once it has been contaminated. At Ellsworth, shallow alluvial deposits on top of the Pierre Shale help control the spread of contaminants deeper than perhaps 30 feet. But the AOC 24 Plume (east of Ellsworth AFB) has spread about 5 miles to the east ... One of the things I keep wondering about is if it's worth the expense of recovering every little bit of TCE

(trichloroethene). We can keep trying to recover it for decades. Some criteria needs to be developed to establish just when it's time to forget about cleaning up the contaminants at Ellsworth AFB. "

This interviewee further suggested that the Ellsworth Environmental Cleanup Team establish a dissolved concentration limit to volume of ground water ratio that will help them decide when its time to safely stop cleaning the contaminated ground water.

Identified Concerns: 1. Perception of the risk to human health and the environment by Base neighbors varies. Off-Base contamination has been major focus of public out reach.

2. Cleanup efforts may take considerable time and it may not really cost effective or necessary to remove all the TCE from the groundwater.

Effectiveness of Ellsworth AFB's Public Outreach Efforts. All the interviewees give the Air Force "high marks" for keeping local community members informed via public meetings, mailings and one-on-one contact. However, they agree that at this point in the cleanup work, the frequency of public meetings should be scaled back. This is due to a notable decrease in new information as the program has progressed from investigations to actual construction of remediation systems.

One interviewee expressed disappointment with the public's general lack of desire to become involved. He wrote, *"Ellsworth ,AFB has spent a lot of money on the cleanup, and as far as I'm concerned, (the Air Force) has done a good job at making documents available to the public ... My biggest disappointment is that the public rarely takes the time to read the documents and make informed comments. They seem to talk (amongst) themselves in terms of vicious rumors and exaggerated concerns. There's probably no way to correct this. "* However, he suggested that weekend public tours of the cleanup sites may help.

One interviewee said that getting timely answers to his questions was a problem early on, but he added that the flow of information improved significantly once construction work got under way.

Identified Concerns: 1. Lack of public's interest in program.

Impacts of Environmental Cleanup Construction Work on Local Community. Two interviewees expressed concerns about the Air Force's agreement with the City of Box Elder that turns over water supplier responsibilities for 68 property owners/residents impacted by ground water contamination northeast of the base.

Prior to discovery of the contaminated ground water plume, these property owners/residents used water from private wells. Once the plume boundaries were clearly defined and the contamination source was positively linked to Ellsworth AFB, the Air Force took action to construct a water main from the base for hooking the impacted properties/residences up to a clean drinking water source. Others living in an established buffer zone outside the plume area were asked to stop using their private wells due to the impact that operating those wells could have on changing the size and shape of the plume. In exchange for doing so, the Air Force also offered to hook their properties/residences up to the base water main. Individual agreements were negotiated with each property owner/resident. A key element of these agreements concerns' predetermined daily water use amounts that the Air Force will pay for. Usage beyond the predetermined amounts specified in the agreements will be paid for by the property owner/resident.

Because Air Force regulations discourage Air Force bases from providing utilities, the Air Force negotiated an agreement with the City of Box Elder for the city to take on the water supplier responsibilities for the northeast property owners/residents. The city completed construction of a new, larger capacity water tower in August 2000, and construction of water lines to reach the northeast property owners is currently under way. The Air Force contributed $217,154 to the $630,000 project that Air Force and city government

officials believe presents a "win win" situation for the Air Force and the city. The Air Force will get out of the water supplier business and the city gains additional water revenue from 68 new customers.

The concerns expressed by the two interviewees relates to the eventual fiscal impact (higher water rates taxes) that maintenance of the additional water lines will have on the citizens of Box Elder, a predominantly low-income community. They're also concerned about the city's ability to meet the increased water supply needs, especially if the number of property owners/residents impacted by the ground water contamination east of the base increases for any reason.

Two interviewees who live northeast of the base expressed concerns about the quality of Box Elder water in terms of its smell and taste. They feel they should have been given a choice about which water supply the Air Force hooked their properties/residences up to, Rapid City water from Ellsworth AFB or Box Elder water.

On another issue, three interviewees expressed concerns about Ellsworth AFB discharging treated ground water into Box Elder Creek versus exercising the option specified in the proposed plan to re-inject the treated ground water back into the ground water table.

They said the treated ground water discharge is not making it to Box Elder Creek because, some time ago, the Department of Transportation plugged off several drainage culverts to prevent flooding at a mobile home park that was built in the area. Because of this action, the natural drainage directs the treated ground water into the ground water table near the Thunderbird housing development. The increased level of the ground water there has caused some flooding in basements of those homes. One interviewee said the effects of this problem are improving as treated ground water discharge rates decrease. However, he added that the problem worsens in years of heavy rain and snow. All three interviewees wanted to know if the Ellsworth Cleanup Team has looked into this problem and if there's a plan in the works to correct it.

Two interviewees mentioned a rumor that has been circulating in the local community. The rumor is that the base is trucking contaminants off base with construction rubble. This is an issue the Ellsworth Environmental Cleanup Team needs to set the record straight on.

One interviewee mentioned an odor that seems to increase in the Box Elder area around the spring and summer months. She wonders if there's a connection to the aeration of volatile organic compounds removed from contaminated soils by Soil Vapor Extraction systems installed at various cleanup sites. She also wants to know if any studies have been done on the health effects of releasing these contaminants into the air.

Identified Concerns:

1. Potential long-term cost of water supply system to residents of Box Elder for water supplied to Off-Base residents outside of Box Elder in the area of the AOC-24 plume.

2. Smell and taste of Box Elder water and the lack of choice on water supply source.

3. Increased groundwater levels in the Thunderbird Housing Development as a result of the discharge of treated groundwater into a drainageway to Box Elder Creek, discharge may have resulted in flooding of basements in some homes.

4. Removal of contaminates off-Base with construction rubble.

5. Odor from the on-Base systems in the spring and summer months.

Other Comments. Several interviewees recommended that the Air Force do more communicating with the people of Box Elder, not just those in city government positions. And, they recommend that when Ellsworth AFB commanders want to gauge community concerns about the environmental cleanup activities at the

base, that they focus their interaction efforts toward the Box Elder community, not the Rapid City community. They feel that the Rapid City community is not impacted in any way - Box Elder community members are the major stakeholders.

Identified Concerns: 1. Base should communicate with people of Box Elder and not just government representatives of Box Elder and Rapid City.

The following information was provided by the Ellsworth AFB project manager from Earth Tech. It deals specifically with construction. and Operations and Maintenance (O&M) issues related to the Ellsworth environmental cleanup sites.

Status of Construction. Construction is complete with the exception of some water main construction east of the base under the Operable Unit 11 project. That construction has been drawn out by the negotiations between the Air Force and various property owners.

O&M Presence. The on-site staff includes a site manager, a lead operator, a second operator and a lab technician. They perform daily and periodic facility O&M; coordinate subcontracted facility O&M; coordinate facility operations with Air Force personnel; and sample the influent and effluent streams as necessary to measure system operation and ensure compliance with regulatory effluent limits.

Significant Changes in O&M Requirements. There have been reductions in O&M efforts due to several factors -- elimination of granular activated carbon treatment at one of the plants; reduction in sampling frequency and a number of parameters at several sites: and installation of a computerized monitoring system at the treatment facility to allow remote monitoring by operations personnel.

Unexpected O&M Difficulties or Costs. Selenium concentrations in ground water have caused some problems with effluent limits. resulting in certain wells being periodically taken out of operation. Fouling of carbon treatment units have also been a problem, but the problem has been resolved by the use of hydrogen peroxide backwashes. and, most recently, by the elimination of chemical sequestrant at one of the plants. Biofouling of wells has occurred, and has been addressed by annual redevelopment of a number of the extraction wells.

Opportunities to Optimize O&M or Sampling Efforts. With the approval of the regulatory agencies, the Air Force has taken some extraction wells out of operation in order to concentrate the remediation effort on the areas of highest contamination. Long-term monitoring has been reduced at several sites, reducing annual costs. Additional extraction welts have been installed in a couple of areas to enhance the operation of the remediation systems.

APPENDIX E

ANNOTATED RESPONSES TO COMMENTS

Response to Comments on Draft Five Year Review for Ellsworth AFB, South Dakota, Dated June 2000
FXBM 997001

Response to comments received from US EPA Region 8. by Jeff Mashburn, dated July 19,2000.

General Comments:

Comment 1. "When contaminants or "classes" of contaminants are first discussed in the document".....

Response: Additional text added to describe the source of material the first time it is mentioned.

Comment 2. "create an acronym page and spell out acronyms when first used"...

Response: List added and spelled out in text.

Comment 3. " For consistency and ease of use....."

Response. Table numbers edit as requested

Comment 4. "In Chapter 3, for each operable unit....

Response. A table listing the chemicals analyzed for each media during the RI is included. The COC for a specific OU are discussed in the text.

Comment 5. " In Chapter 3, for each OU, there is repetitive wording...."

Response. Wording is included in each OU since a reader may be looking at only one OU, and would not necessarily read an opening section when looking for the risk assessment information. Information providing clarification of the terms acceptable was added to the text.

Comment 6. "Any reference in this document to natural....."

Response. Text changed to indicate monitored natural attenuation.

Specific Comments:

Comment 1. Title Page: Insert ....."

Response. "Air " added to text.

Comment 2. Page 1, Section 1.2, 2nd paragraph: Insert the word "statutory"..."

Response. Changed as requested

Comment 3. Page 2, Section 1.2: Under "CERCLA Sites:" Should AOC 24 be mentioned..."

Response. AOC-24 added to the OU-11 list.

Comment 4. Page 5, Table 1: Please clarify the "low-level nuclear waste" that is ....."

Response. Table edited to reflect "Waste Generating Actions" rather than "Hazardous Substance Activities" and LLRW removed from the last table column for current conditions. LLRW is defined in table.

Comment 5. Page 7, Table 3:. Ensure dates that are italicized....."

Response. Dates corrected.

Comment 6. Page 8, Section 3.1, 3rd paragraph, last sentence: "IS the USAF....."

Response. Current data added to text.

Comment 7. Page 8, Section 3.1 4th paragraph, first sentence: "Does the word....."

Response. Yes.

Comment 8. Page 9, Section 3.1, 3rd paragraph: "The text says"five off-Base...."

Response. Text modified to reflect that these are private domestic supply wells, as is PW01.

Comment 9. Page 9, Section 3.1, 3rd paragraph: "Figure 3-3 is referenced....

Response. Corrected figure added.

Comment 10. Page 11, Section 3.2.2, 3rd paragraph: " the test states"In spite of this....."

Response. Yes this issue is discussed in the Ecological Risk Assessment.

Comment 11. Page 13, Section 3.3.1, 3rd paragraph: "Please clarify...."

Response. Sentence re-written to clarify the discussion of the landfill boundary.

Comment 12. Page 16, Section 3.3.3 3rd paragraph: "The first sentence indicates.

Response. Text modified to indicate that " results of the risk assessment indicated that surface water was not a media of current concern , because the chemicals detected in the ground water, which contributed to excess risk, are considered to be naturally occurring.'...

Comment 13. Page 16, Section 3.3.3 4th paragraph: "This paragraph should....."

Response. Paragraph was re-written. "Remedial action was considered warranted for the landfills based on the potential risk to human health from future releases of hazardous substances from the landfills. Contaminants in the landfills may leach downward to contaminate the underlying ground water. Off-Base residents may then ingest or come in contact with the contaminated ground water. Also, the surface of the landfills may erode, thus exposing

Base personnel doing maintenance work to disposed hazardous substances."

Comment 14. Page 17, Section 3.4.4, 4th paragraph: " The text states" tetrachloroethylene (PCE)...."

Response. Yes

Comment 15. Page 20, Section 3.5.3, lst paragraph: "Please clarify the discrepancy between the ....."

Response. Paragraph was re-written. "The landfill was primarily active between 1965 and 1976 as a trench and fill operation. Disposal trenches were approximately 13 to 15 ft deep. A recent examination of 1946 and 1952 aerial photographs of EAFB indicated that some landfill activity may have occurred prior to 1965. Also records indicate that one open trench was used for disposal of construction demolition debris during the mid-1980s. Digested wastewater treatment plant biosolids was also added to the landfill at this time. Solid waste generated on-Base has been disposed of by contract at an off-Base sanitary landfill since 1976."

Comment 16. Page 22, Section 3.5.3, 6th paragraph: " The text should be re-written to clarify that ....."etc.

Response. Paragraph was re-written. "If not remediated" added to paragraph.

Comment 17. Page 24, Section 3.6.3, 5th paragraph: "In the first sentence....." But the ....."

Response. Paragraph was re-written. "Part of the site risk present at OU-5 includes risk from exposure to surface soil contaminants from within the landfill. In addition, due to the heterogeneity of the landfill contents, there is some uncertainty associated with the calculated risk values for the surface soil. The risk assessment for OU-5 indicated that the carcinogenic risk was within the acceptable risk range of 1×10^{-4} to 1×10^{-6}' and there were no non-carcinogenic risks resulting in an HI above 1.0."

Note. The comment on uncertainty is reflective of the risk assessment process as a whole due to the many factors that effect the actual risk as compared to calculated or estimated worse case risk estimates.

Comment 18. Page 25, Section 3.6.3, 5th paragraph: "The last sentence indicates ..... assessment", Was.....?"

Response. Yes

Comment 19. Page 25, Section 3.7.2, lst paragraph: " This paragraph is not clear ..... golf course. Was fill ..... used at golf course?"

Response. Paragraph re-written. “Two distinct types and areas of fill material were found at OU-6. The first type of fill material was clean till used on the eastern portion of the OU, probably during construction of the golf course, and consists of re-worked soil and organic material. The organic material was described in the field as black organic humus type material resembling WWTP sludge material and plastic. and may have been used as a soil amendment when the golf course was built. The second type of fill material is landfill material which consists of construction debris and demolition debris. Construction and/or demolition debris consists of broken concrete, broken brick, asphalt. and wood.”

Comment 20. Page 28, Section 3.8.2, 1st paragraph: “This text conflicts .... with page 87....”

Response. The following change was made to the text: “Remedial actions implemented at the OU consisted of the application of institutional controls and ground water monitoring. A removal action was completed at the OU to remove low level radiological waste materials buried at this OU. The material was removed and disposed of according to current EPA and Nuclear Regulatory Commission requirements.”

Comment 21. Page 29, Section 3.8.3: "The text on page 87 states that “ A low-Level radioactive waste (LLRW) removal ..... which contradicts this sections text....”

Response. See response to comment 20.

Comment 22. Page 31, Section 3.9.3, 1st paragraph: “The text states” the earthen dams ..... water flow. But does not..... issue”

Response. Text added as follows: “These dams were rebuilt as part of the remedial actions taken at OU-8.”

Comment 23. Page 37, Section 3.12.3, Area 2, 2nd paragraph: “The text describing AOC24..... the contamination"

Response. Text added: “The contaminant plume has been defined east of the Base and currently extends approximately 5 miles to the east of the Base boundary. Private water supply wells in the plume area have shown elevated TCE levels, the Base has installed a water line to provide an alternate water supply for the affected properties, until the TCE plume is remediated.”

Comment 24. Page 43, Section 3.14.3 2nd paragraph: “ the text refers to Figure 3-34..... copy”

Response. Figure 3-34 provided.

Comment 25. Page 45, Section 4.1.1 last paragraph: ‘The text states” “additional well will ..... Is this .....done?”

Response. Text modified. Wells have been added as part of the remedial action.

Comment 26. Page 47, Section 4.1.1, 3rd paragraph: “ The text ..... no longer in use.”

Response. Text re-written as follows: "The thermal oxidizer is no longer needed, due to the low level of volatile emissions, and has been removed from the treatment system.

Comment 27. Page 47. Section 4.1.1, 4th paragraph: "The text refers to the continuing order.....copy ..... document."

Response. A copy is included in Appendix C.

Comment 28. Page 51. Section 4.1.2, 3rd paragraph: " The text implies that Figure 4-3..... Does Figure 4-3 show ..... currently configured?"

Response. New figure provided.

Comment 29. Page 51. Section 4.1.3, last paragraph:" The text ..... Figure 4-4. Is Figure 44..... Wells?"

Response. New text provided.

Comment 30. Page 57. Section 4.3.1: " the text should ..... operation and maintenance".

Response. New figure provided.

Comment 31. Page 59. Table 7: "A key should be..... component"

Response. Footnotes added to table.

Comment 32. Page 61. Table 7: "The completion ..... blank."

Response. Table updated.

Comment 33. Page 62. Table 7: "Footnotes are missing"

Response. Footnotes added.

Comment 34. Page 63. Section 4.3.2, last paragraph: "Provide the .....revised."

Response. Date inserted into text.

Comment 35. Page 64. Table 8: "The table does not..... controls"

Response. Corrective action added to table.

Comment 36. Page 71. Section 6.3, 2nd paragraph: "the text ..... to be completed."

Response. Text changed to read: "Gamma chlordane is a broad-spectrum insecticide and was used extensively in agriculture and for termite control in the 1980s, since that time

its use has been restricted and EPA has issued a no use restriction on food products".

Comment 37. Page 84, Section 7.1.2. 2nd paragraph: " The text does not..... restricted areas, etc."

Response. Text re-written as follows: "The Base made immediate evaluations of the action and has repaired the cover. This effort included, review of operation directives, providing for additional staff/personal training, completion of sampling and analysis of surface soil samples to determine if COCs had been released, installation of new signage, development and distribution of a new Base map showing environmentally restricted areas, and re-issue of the Base Commander Continuing Order Policy."

Comment 38. Page 85, Section 7.1.3: " While institution .....employed"

Response. IC narrative added.

Comment 39. Page 86, Section 7.1.3: 1st paragraph," The text is inconsistent ..... discussed.

Response. Narrative corrected.

Comment 40. Page 86, Section 7.1.3: 4th paragraph, " the last sentence " it is .....future" Is it... MCLs?"

Response. MCLs were used as the cleanup goals for the OU.

Response to Comments on Draft Five Year Review for Ellsworth AFB, South Dakota, Dated June 2000
FXBN 997001

Response to comments received from US ACE, comments by Jim Moore. CENWO-ED-GI, dated July 21,2000.

Comments:

Comment 1. Section 6.3, Page 71, "Five COCs have had toxicity value of limits ..... EAFB. This section refers the reader to Table 6-19, page 83.. The table does not mention the source of the data, nor..... oral slope, inhalation slope ..... refernce concentrations .... COCs.

Response: Noted, the table has been revised to include additional data.

Comment 2. Section 7.2.3, page 90, " states the "the change ..... not expected to .....at EAFB"

a. Document does not have Table 6-10.
b. No evidence is offered for why the change ..... no effect conclusion is not stated."

Response:

a. Table 6-10 should be 6-9. This table has been modified and updated to included information noted in comment 1.
b. Text has been revised and expanded.

Comment 3. " I am not certain ..... screening value of 400..... If it was .....text should have stated that fact"

Response. Correct the 400 ppm screening value was not used during the RI risk assessments or in the five-year review. No lead levels were observed near this level during the RI.

Comment 4. "In lieu of recalculating the quantitative ..... as an expanded table 6-19. In addition ...a qualitative statement should be made as..... increase or decrease the risk to receptors at the site."

Response. The text and table 6-19 have been updated. A recommendation from this five year review will be to develop a master list screening values for the Base and to compare that list with EPA Regional screening levels.

Response to Comments on Draft Five Year Review for Ellsworth AFB, South Dakota. Dated June 2000 FXBN 997001

Response to comments received from US EPA Region 8, comments by Susan Griffin, dated June 26,2000.

Comments:

Comment 1. "The dermal risk calculations are .....1989 EPA guidance. If the current Dermal..... was used , chances are the dermal risk would be less."

Response: Noted, no change was made to the text in this regard.

Comment 2. " although introductory sections ..... 10% chromium ..... the other option is to speciate the chromium upon analysis."

Response: Understood. The risk assessments were reviewed with comment in mind. No additional information was added t the five year review however at this time. Re-calculation of risks were not completed as part of this review. However further review or comparison to EPA Regional screening values may be included as recommendation for the next review process.

Comment 3. " although EPA uses 400..... did not appear that .....used at any operable unit."

Response. Correct the 400 ppm screening value was not used during the RI risk assessments or in the five-year review. No lead levels were observed at these concentrations during the RI.

Comment 4. "Inhalation non-cancer toxicity values in these ..... derived ....converting to inhalation values. Most toxicologists feel that it is inappropriate to extrapolate from ... so we generally don't."

Response. We understand the current position of not extrapolating the values. The five year review did not re-calculate risk at the site. However the oral RFDs and other information in the related reference table in the text have been updated with available data (Table 6-19). A recommendation for the next review will be made to include comparison of the new values in the table as well as EPA Regional screening values to current site concentrations, rather than complete recalculations of risk.

Comment 5. Oral RFDs are now available for....."

Response. Date added to Table 6-19.

Comment 5 [6]. Oral cancer ..... revised for....."

Response. Data added to Table 6-19.

Response to Comments on Draft Five Year Review for Ellsworth AFB. South Dakota, Dated June 2000 FXBN 997001

Response to comments received from SDDENR, comments by Leland Baron, dated August 24,2000.

Comments:

Comment 1. "Develop a list of acronyms used in the document."

Response: List added

Comment 2. " Delete the sections and .....to remedial actions .....under state authority ..... as well as references in the document."

Response: Understood. This information was added to the document at the request of the RPM and had agreement from the RPM group. It is understood that this is not a CERCLA issue but the remedial actions at some of the OUs do affect both CERCLA and non-CERCLA contaminants that is some cases may be intermingled. The information was retained in this the first five-year review.

Comment 3. Section 3, Background, Initial Response: " Please clarify first ..... CERCLA and Non-CERCLA ....."

Response. This text has been changed as indicated.

Comment 4. Page 38,, Area 2: "Add more explanation tot he description of Area of Concern 24.....

Response. Agreed. Additional text was provided.

Comment 5. Page 58, Table 7: Please add footnotes for this table.

Response. Footnotes added.

Comment 6. Page 70. Section 6.1: " The language concerning the change to state TPH..... Please delete the sentence stating the TPH action level declined from 10,000 mg/kg to 500 mg/kg."

Response. Text edited as recommended.

Comment 7. Page 85, OU-2: " Change mustard agent to mustard agent test kits in the third paragraph."

Response. Edit made as recommended.